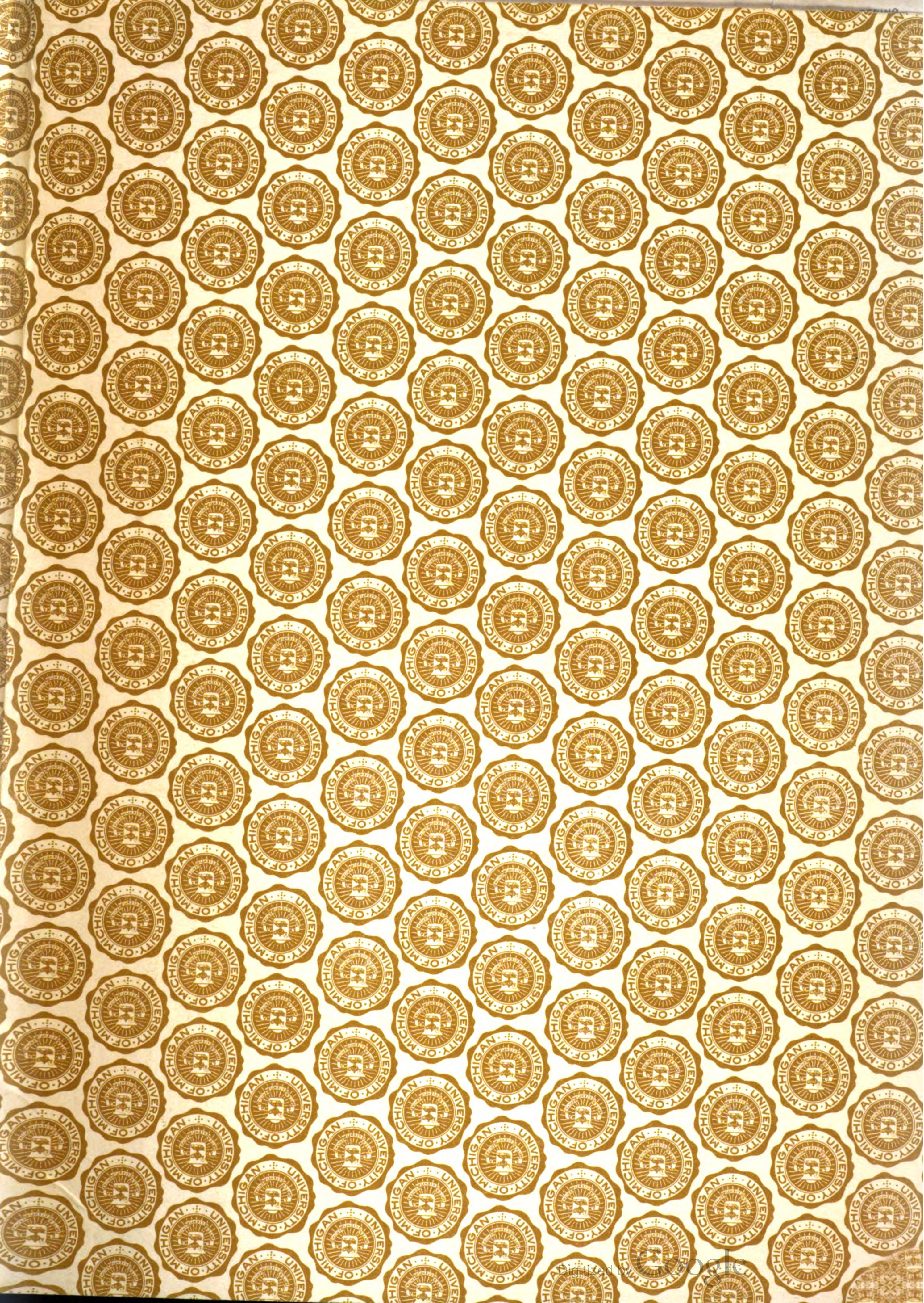
This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com

[redacted]
C 3 9015 00357 832 8
University of Michigan – BUHR

1837
ARTES VERITAS SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
TUEBOR
SI QUAERIS PENINSULAM AMOENAM
CIRCUMSPICE
COLLEGE
OF
ENGINEERING



LIBRARY

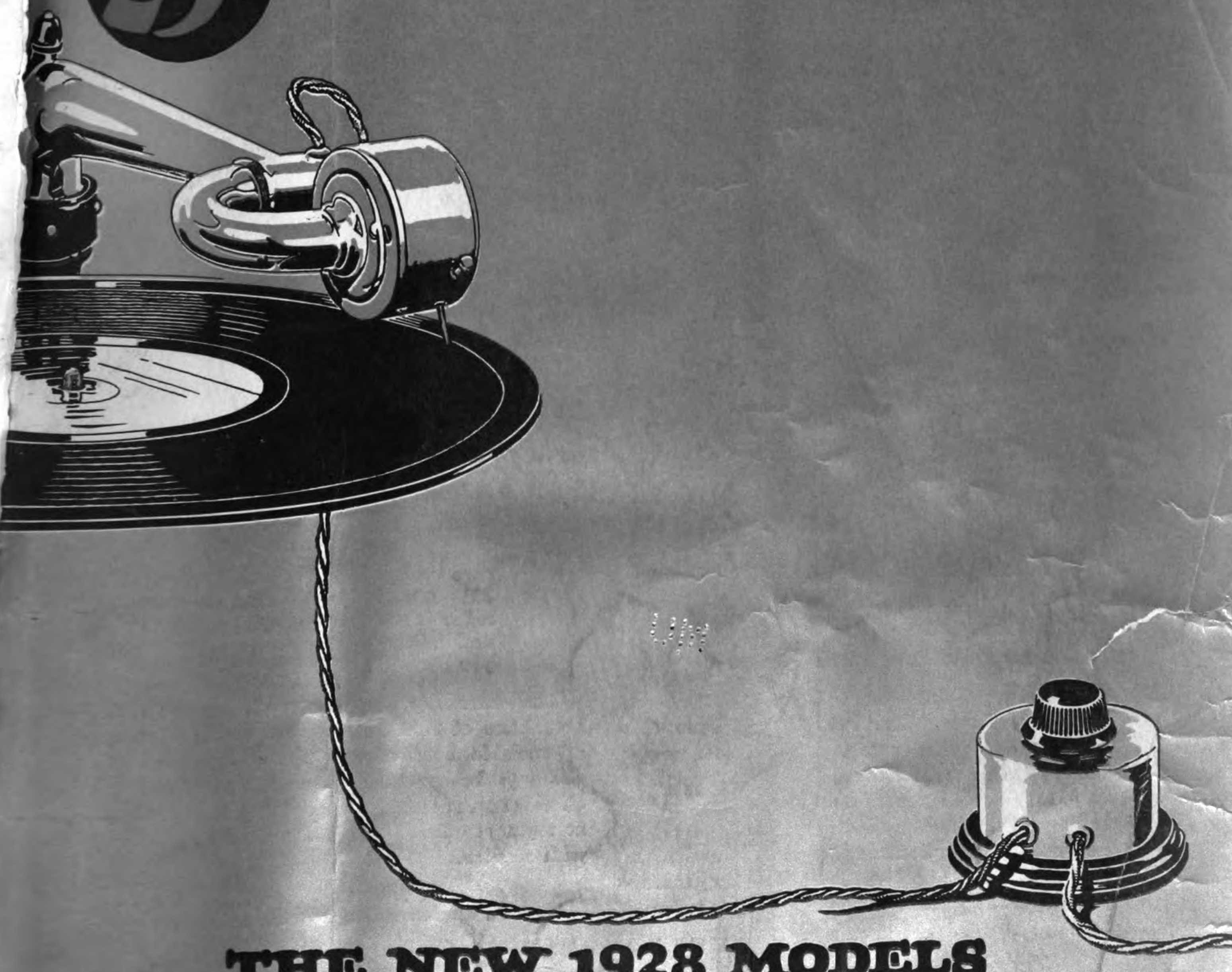
TK
6540
P83

Popular Radio

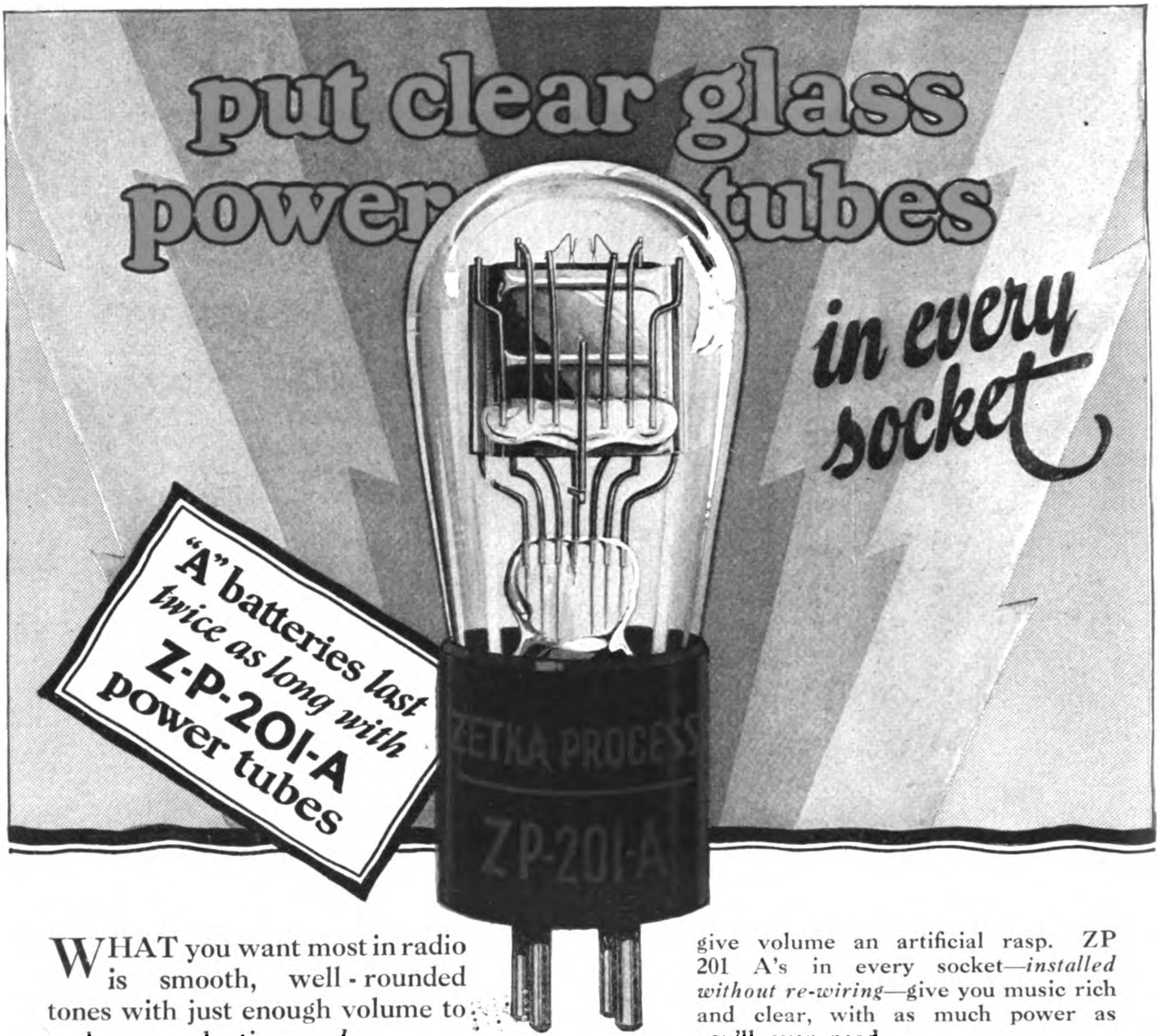
JULY ▾ AUGUST ▾ 1927

SEP 2 1927

25¢



THE NEW 1928 MODELS *of* RADIO RECEIVERS ▾ LOUDSPEAKERS *and* ACCESSORIES



WHAT you want most in radio is smooth, well-rounded tones with just enough volume to make reproduction *real.*

The new ¼ amp. oxide filament ZP 201 A all-socket Power Tubes now contribute this missing quality to radio. ZP 201 A power tubes take just enough current from your battery to assure smoothness of tone. Differing from the majority of other tubes, there is no excess—no "crowded" current active in ZP 201 A's to set up the blasting microphonic noises that distort true tone and give volume an artificial rasp. ZP 201 A's in every socket—*installed without re-wiring*—give you music rich and clear, with as much power as you'll ever need.

The extremely conservative operating characteristics of ZP 201 A power tubes effect an appreciable economy in "A" power—reduces recharge bother and expense. And through elimination of magnesium coating, they perform at topmost efficiency . . . actually improving with service.

A better, longer life power tube at only $2.50 each.
Ask for a demonstration at your nearest dealer.

ZETKA LABORATORIES, Inc., 73 Winthrop St., Newark, N. J.

ZETKA
The *Clear Glass* Tube

Presenting a NEW BROWNING-DRAKE

MODEL 7-A

SINGLE DIAL SEVEN TUBES
COMPLETELY SHIELDED
ILLUMINATED DRUM CONTROL
SUPER-SELECTIVITY

AFTER several years of intensive research by G. H. Browning and Dr. F. H. Drake, the laboratories of the Browning-Drake Corporation have brought to commercial form an entirely new conception of the world-famous Browning-Drake receiver.

Ability to cut through the strongest local interference, and remarkable distance performance, even superior to previous accomplishments, give this new receiver an unmistakable appeal, although Browning-Drake receivers have a record of seven successive nights of transcontinental reception. The first Browning-Drake to use more than five tubes, this new receiver embodies many mechanical refinements, including complete shielding and a highly efficient and novel tuning drive system.

As the culmination of nearly five years of study and progress, and backed by the reputation of the Browning-Drake Corporation, this receiver, we believe, will occupy a paramount position in radio this year. High grade dealers throughout the country are prepared to offer several models of these new Browning-Drake sets, as well as the official Browning-Drake kit for home assembly, which has won wide-spread popularity.

Every fan knows Browning-Drake. Thousands own the factory-built receivers. And more fans are building the official Browning-Drake kit sets than any other type of kit assembly.

DEALERS: Browning-Drake now offers a complete line of receivers and kit parts. Sales of Browning-Drake parts during the past season were more than twice those of any other. Inquiries will receive prompt attention.

BROWNING-DRAKE CORPORATION
CAMBRIDGE :-: MASS.

BROWNING-DRAKE
RADIO

Popular Radio

FOUNDED 1911

VOLUME XII July-August, 1927 NUMBER 1-2

CONTENTS

(*Cover design by Frank B. Masters*)

The Wedding of the Radio Receiver and the Talking Machine

FRONTISPIECE..........PAGE 10

The New Prospects of Transmitting Power by Radio

Will power be transmitted some day by means of luminous beams of air made conductive by radio waves? Here are some interesting speculations in this new field of radio science

By Thomas Elway........PAGE 11

How to Add the New Radio Amplification Units to Your Phonograph

Here, at last, is an electrical device by means of which you can give that old phonograph a tonal quality and range equal to the best radio set

By Laurence M. Cockaday....PAGE 14

How to Assemble the New Unitune Receiver

A receiver designed with the idea of simplicity and low cost—the needs of the average listener

By Joseph Calcaterra.......PAGE 18

The New "Exponential Horn"

Mathematical theories of sound have given radio this latest method of lifelike reproduction

By David Lay.........PAGE 22

A New Amplifier for Your Old Set

How to build an amplifier that employs resistance and transformer coupling

By the Technical Staff......PAGE 25

The New 1928 Models in Radio Receivers

Advance information to the readers of POPULAR RADIO on what will be offered in the radio market for the next year

By the Technical Staff.......PAGE 28

What's New in Radio

By the Technical Staff......PAGE 34

The Latest Radio Valves

The new valves mark one of the most distinct advances that radio has made in its history. Here is valuable information for both the fan and the experimenter

By the Technical Staff.......PAGE 42

A New Kink for Keeping Your Log-Book

By W. Penn Lukens........PAGE 52

How to Build the Capacidyne Receiver

Details for building a receiver that embodies new ideas in high-frequency amplification

By Herbert Snead.........PAGE 54

The Coming of the New LC-28 Receiver

PAGE 58

DEPARTMENTS

With the Experimenters.......*S. Gordon Taylor*.......... 60
In the World's Laboratories....*E. E. Free*................ 62
  How the New Television Works
  What Noises Annoy?
  Radio Waves Make New Chemistry Possible
  Noises from Northern Lights
Star Program Features of the Month...................... 64
Broadcast Listener............*Raymond Francis Yates*.... 82
Broadcasts.................................... 88
The Beginner in Radio.........*Armstrong Perry*.......... 94

VOLUME XII July-August, 1927 NUMBER 1-2

Published monthly by Popular Radio, Inc., 627 West 43rd St., New York, N. Y.; telephone number, Chickering 1906; Douglas H. Cooke, President and Treasurer; Kendall Banning, Vice-President; Laurence M. Cockaday, Secretary; Emma A. Harm, Asst. Treasurer. Price, 25 cents a copy; subscription, $3.00 a year in the U. S., Canada and all countries within the domestic postal zone; elsewhere, $3.50 a year, payable in advance. The International News Company, Ltd., No. 5 Bream's Bldg., London, E. C. 4, sole distributors in England. Entered as second-class matter April 7, 1922, at the Post Office at New York, N. Y., under the act of March 3, 1879. Additional entry at Jamaica, L. I., N. Y. Copyright 1927, and title registered as a trade-mark by Popular Radio, Inc. Copyright in Great Britain by Popular Radio, Inc., 6 Henrietta St., Covent Garden, W. C., London, England. *For advertising rates, address* Popular Radio, Inc., 627 West 43rd St., New York; or 225 North Michigan Ave., Chicago.
Printed in U. S. A.

KENDALL BANNING, *Editor*

LAURENCE M. COCKADAY, *Technical Editor*

E. E. FREE, Ph.D., *Contributing Editor*

The True Magic of Music From Your Radio and Phonograph With These New Alden Devices

Amazing New Invention Makes it Possible to Obtain Radio Quality and Realism of Radio From Phonograph Records

Any radio engineer will admit that the improvements that have been made in radio reproduction during the past three years have been confined largely to audio-frequency amplifiers. The set of yesterday—of 1925-26—is antiquated, not because of its sensitivity or selectivity but because its audio-frequency apparatus *does not pass all the frequencies of the musical scale.* The mellow and rich low notes are practically absent and the absence of these frequencies gives to the music a colorless, nasal nature.

Any Set Modernized With Truphonic Amplification

Through the development of the marvelous Alden Truphonic Amplifier, an amplifier based on the very latest engineering discoveries, any radio set, *regardless of its age or manufacture,* may be brought up to the 1928 standard of reproduction through the simple expedient of making a few connections. For one-twentieth of the price of a new receiver, any novice, regardless of his experience in radio, can bring his old receiver to a point of audio-frequency efficiency where it will match and even surpass many of the high-priced sets of today. Music with a quality never before believed attainable is made instantly available through the quick and convenient attachment of an Alden Truphonic Amplifier.

Perfect Realism With Truphonic

A Truphonic Amplifier is simply this: A small, compact instrument which, when attached to your receiver, changes entirely the amplification of your set. As if by magic, it brings out the true musical qualities that have heretofore been distorted by old-fashioned and hopelessly antiquated audio-frequency systems. A Truphonic Amplifier also has the decided advantage that for those who want exceptional volume with the same pure quality of reproduction, may have it by the simple addition of a power tube. No other changes are necessary, no additional "A" or "B" battery being required.

The Wedding of the Phonograph and the Radio

Through the use of the Alden Truphonic Amplifier and the new Alden electrical phonograph reproducer, the wedding of the phonograph and the radio has been successfully brought about. Using these two devices, it is possible for the radio fan, for the first time, to enjoy phonograph concerts. The Alden electrical phonograph reproducer is attached immediately to any phonograph, regardless of its type or age. This device converts the delicately recorded impressions on the record into minute electrical currents which are perfectly amplified through the Truphonic unit. Thus, by a quick and simple change, the radio fan may use his radio or his phonograph.

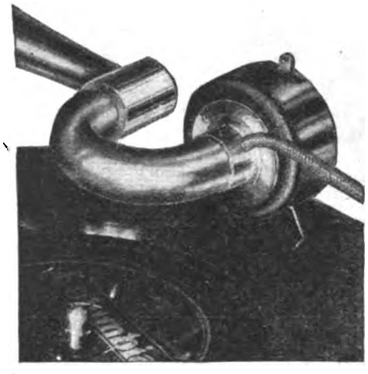
A Matchless Combination

These two new Alden devices make of any phonograph a reproducer equivalent to the high-priced electrical phonographs being sold at the present time. For a few dollars the owner of an old radio receiver and an old phonograph may enjoy this matchless combination and the new thrill of true musical reproduction. By the addition of these units, you not only bring your radio set up to date, but you bring your phonograph up to the new standard of electrical reproduction along with it.

No Other Phonograph Unit Has These Features

The Alden electrical phonograph unit is a masterpiece of acoustical engineering, having features that cannot be claimed by any other device of its kind. Nothing in a phonograph record eludes its searching needle. These new features make possible a realism of reproduction that is perfectly amazing.

The Alden unit requires nothing from a phonograph but a turn-table. It replaces the old sound box and may be attached in a twinkling of an eye. Embodied with the Alden unit, there is a volume control which makes possible music from a whisper to the full blast of a jazz band. There is also incorporated in this unit the new Alden feature that entirely eliminates all needle scratch. This needle-scratch filter is a distinct Alden feature and is not available on any other device of this nature.



The Alden Electrical Phonograph Reproducer

The Alden unit is attached to any phonograph by a simple twist of the wrist, converting the instrument at once into a fine electrical reproducer of music. Although best results are had when used with the Alden Truphonic Amplifier, the unit may be permanently attached to any standard radio receiver by making a few simple, quick connections.

Price Complete with cord ***$10.00***

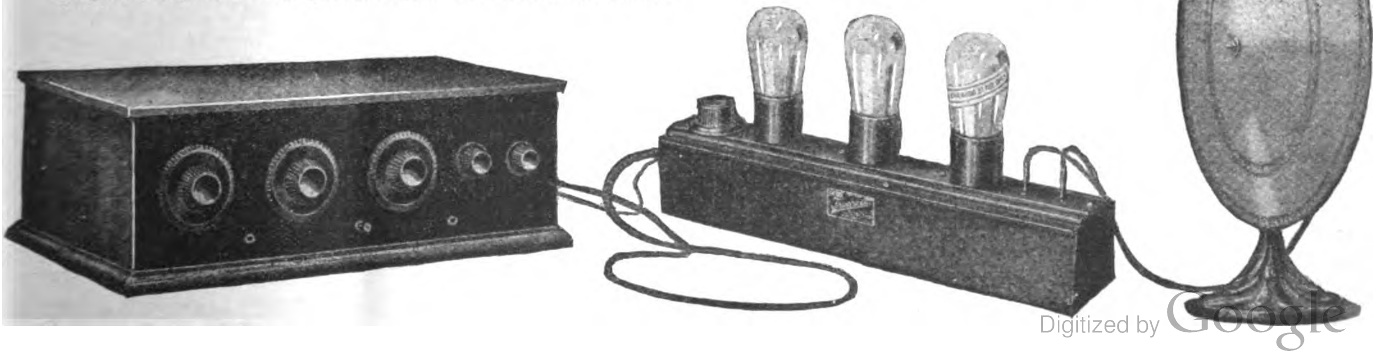
The Alden Manufacturing Company makes many other radio necessities, and radio fans are invited to send for a complete catalog of sockets, dials, adaptors and loudspeakers.

ALDEN MANUFACTURING CO.,
SPRINGFIELD :: :: MASSACHUSETTS

The Alden Truphonic Amplifier

This unit comes complete in a beautifully finished case with labeled leads for ready attachment to any receiver, regardless of its type. A volume control is also provided, together with phone tip-jacks. Comes packed with full instructions for quick, easy attachment.

Price $25.00



A PAGE WITH THE EDITOR

From a photograph made for POPULAR RADIO

A Practical Demonstration of the Electrical Pick-up Apparatus by the Technical Staff of POPULAR RADIO

The results of many months of experimental work in the radio laboratories of several manufacturers and inventors, supplemented by independent experimentation and research in the **POPULAR RADIO LABORATORY,** ***were revealed to various groups of engineers, manufacturers, radio and phonograph dealers and to the press in a series of highly successful demonstrations held at the Hotel Astor, New York, from May 20 to 24, inclusive. Some of the various electrical pick-up apparatus and loudspeakers that were here given an impressive demonstration are described on pages 14, 15, 16 and 17 of this issue.***

THIS issue of POPULAR RADIO is devoted practically in its entirety to "what's new in radio."

* *

NEW applications and uses of radio apparatus, new types and models of radio receivers and accessories, new inventions in the field of radio, new demonstrations of radio phenomena—indeed, all that is of most timely interest to the radio experimenter and to the broadcast listener—are here presented to POPULAR RADIO readers, as evidence of what the coming season has in store for them.

* *

AND it may truthfully be said that never before in the history of radio have so many advances been made in a single season.

* *

ASIDE from the progress made in the development of apparatus, this coming 1928 season is marked by two inventions that are of outstanding significance:

* *

FIRST: the "electrical pick-up," by means of which radio apparatus can be successfully used for amplifying and beautifying the reproduction of phonograph records, and;

* *

SECOND: the "exponential horn," which has been in the course of development for three years, but which is only just about to be placed at the disposal of the radio public.

* *

BOTH of these instruments are substantial contributions to the radio world—and the articles on pages 14-17 and 22-24 of this number contain authoritative information that has, until now, been guarded as confidential.

* *

AN excellent constructional article that tells exactly how to build one of the new exponential reproducer horns that give a quality of reproduction superior to practically any other type will be a feature of the coming month's issue of POPULAR RADIO. The details of size, shape and methods for building the forms to make the horn are clearly told for the special benefit of the radio experimenter who wants to get the best reproduction possible.

THE inauguration of the department "Star Program Features of the Month" in the April issue of POPULAR RADIO made an instant hit with our readers—if the large number of congratulatory letters are any criterion.

* *

HERE, for example, is a representative commentary concerning this new feature; it comes from Dr. R. du Valle Sarraga, of San Juan, Porto Rico:

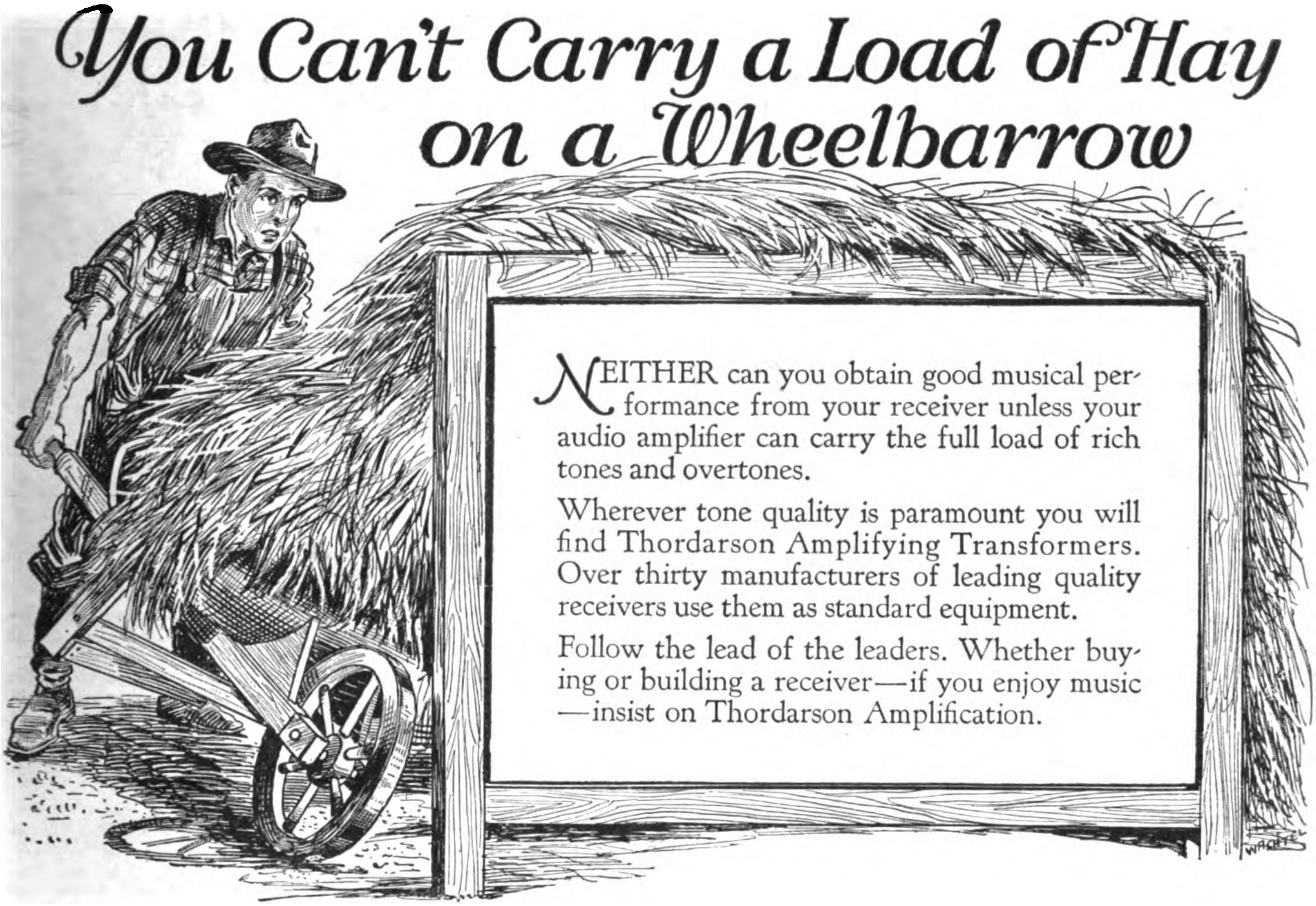
* *

"I CONGRATULATE you for your innovation in publishing a list of star program features. You are rendering a distinct service to the public. The policy of the newspapers in omitting mention by name of these features, in order to increase their incomes through forced advertisements, has received a tremendous blow. The readers of POPULAR RADIO (and I am an old one), are willing to pay the subscription price more than ever, now that they have *real* programs."

Kendall Banning—

Editor, POPULAR RADIO.

You Can't Carry a Load of Hay on a Wheelbarrow



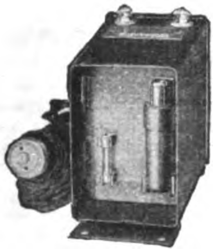
NEITHER can you obtain good musical performance from your receiver unless your audio amplifier can carry the full load of rich tones and overtones.

Wherever tone quality is paramount you will find Thordarson Amplifying Transformers. Over thirty manufacturers of leading quality receivers use them as standard equipment.

Follow the lead of the leaders. Whether buying or building a receiver—if you enjoy music—insist on Thordarson Amplification.

You don't have to be water boy to the

THORDARSON BATTERY CHARGER



DRY—As dry as they make them. In fact the rectifying element is contained in a moisture-proof cartridge.

SILENT—No vibrating parts. Current is rectified through a patented electro-chemical process.

SAFE—There is no hazard to rugs or woodwork for there is no acid to spill. The tubes of the set are safe, even if turned on when the charger is in operation.

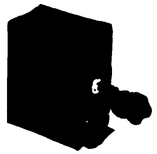
COMPACT—Fits into battery compartment easily. Only 2¾" wide, 5¾" long and 4¾" high, overall.

EFFICIENT—This charger is always ready for service. No overhauling required. Rectifying element is held in spring clips and can be replaced in thirty seconds.

LONG LIFE—The Raytheon rectifying unit used in this charger is guaranteed by its manufacturer for 750 hours of full load operation, or approximately one year's service. The transformer will last indefinitely.

CHARGING RATE—2 amperes.

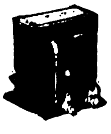
Price $12.50



THORDARSON
Power Compact

The only complete foundation unit for home-built power amplifiers. Contains power supply transformer, 2 30-henry choke coils, 2 buffer condensers and center tapped filament supply—all in one compound filled case. Supplied in two types: R-171 for Raytheon rectifier and UX-171 power tube, and R-210 for UX-216 B rectifier and UX-210 power tube.

Type R-171, $15.00
Type R-210, 20.00



THORDARSON R-200
Amplifying Transformer

A transformer designed for the musical epicure. The large core of finest silicon steel and the high inductance primary winding combine to give this instrument the most perfect transformer reproduction obtainable. Has a remarkably wide range of amplification. Ideal for use with cone type speakers. Designed for both first and second stage amplification. Weight, 2 lbs.

Price $8.00

THORDARSON

RADIO TRANSFORMERS

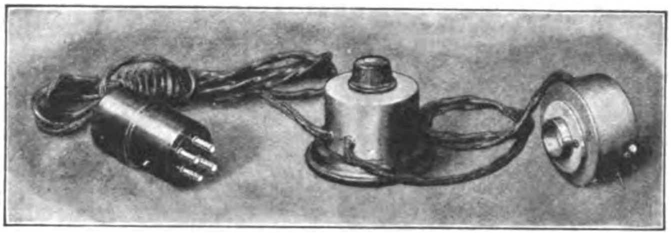
Supreme in Musical Performance!

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer specialists since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.

355-J

The Warford Electrical Reproducer Literally Brings Your Favorite Phonograph Records to Life

Amazing Realism and Greater Volume Possible by the Use of Your Present Receiver



Warford Reproducer for Phonographs

The Warford Unit comes supplied with volume control and 12 ft. cord for attachment to any radio receiver. Cord is equipped with special plug for quick change from radio to phonograph reproduction.

Price $16.00

New Thrills from Your Set

The Warford Reproducer is a device that replaces the regular reproducer with which the talking machine is equipped and transmits and amplifies the record through the loud speaker of any radio set. The Warford unit may be easily and quickly attached to any phonograph or any standard radio receiver. Thus, for the first time, the thrilling realism of radio, the life-like reproduction of broadcasting, may be had from the phonograph record. For the first time it is possible to enjoy the full charm of Caruso's voice or the enchanting music of the New York Philharmonic.

The Renaissance of the Phonograph

The Warford Reproducer marks the Renaissance of the phonograph; music from the plaintive whisper of a violin to the full swell of a great organ, with a fidelity of tone never dreamed possible by acoustic engineers. Once more the phonograph becomes a source of potential entertainment through the employment of radio equipment.

Attached Instantly

The attachment of the Warford Reproducer requires no tools. For its installation, it is only necessary to remove the mechanical reproducer from the phonograph and replace it with the Warford electrical pick-up. The detector tube is removed from the radio receiving set and replaced by a special plug supplied with each Warford unit. No additional wires or equipment is required.

Eliminates Record Noise

This amazing new invention not only makes available radio reproduction from phonograph records, but also eliminates the annoying needle scratch and record noises. The age or manufacture of the phonograph used is immaterial, for the phonograph is called upon only to turn the record. Anyone owning a phonograph may now enjoy the marvel of electrically produced music as supplied by the newer phonograph creations.

The New Warford Power Unit

The tone quality of your set is far more satisfactory when the tubes are not "pushed." But to afford adequate entertainment you are inclined to force the tubes, with the resulting distortion of tone. The further this is carried, the more unpleasant this lack of purity becomes, until many people believe that volume in itself is unpleasant.

Secret of Pure Tone

Yet the music from a good orchestra is equally pleasing whether you are nearby or in the far corners of an auditorium. This is because the tone is pure, and consequently, carries. The Warford Power Unit will give you this adequate volume to be heard at a distance, and, not only will not distort, but will purify and smoothe out the tone qualities of the set. It will make it possible to enjoy your set without the necessity of "huddling" in the immediate vicinity. In fact, it will give a volume that will fill an auditorium or hall and make it possible to dance by radio.

The WARFORD POWER UNIT operates off 120 volts A.C. 60 cycle current, and requires no batteries.

In addition it contains a "B" eliminator that will furnish adequate B current for your set.

This unit is designed to use interchangeably either Donle, R. C. A. or Cunningham Tubes.

It is furnished complete for use including both rectifier and power tubes. It has an 8 ft. cord and plug for connecting to house lighting circuit. Also has attached a 6 ft. cord fitted with tips for connection to speaker terminals on set. It is equipped with terminals for speaker connections and for "B" battery leads from set.

Modernize Your Old Set

The Warford Power Unit will bring your radio set up to date and make reproduction from your phonograph records still more enjoyable, bringing out the full, rich, round tone that you have heretofore been missing. The Warford Power Unit will make even the most modest radio set the equivalent in reproduction to the highest priced radio sets on the market today.

Warford Batteryless Power Amplifier and Eliminator

The Warford Power unit comes in a beautifully japanned metal case with 8 ft. cord, speaker extension and terminals ready for immediate attachment to 60 cycle lighting circuit. Uses either Donle, RCA, or Cunningham tubes, DR 4, U X 213 or C X 313 rectifier tubes or Donle DP 10, RCA, U X 210 or Cunningham C X 310 amplifier tubes.

Price $54.50

Music lovers, dealers and jobbers are invited to write for further information and literature.

WARFORD ELECTRIC, Inc.
42 WHITEHALL STREET
NEW YORK, N. Y.

Eng Lib
Waiv

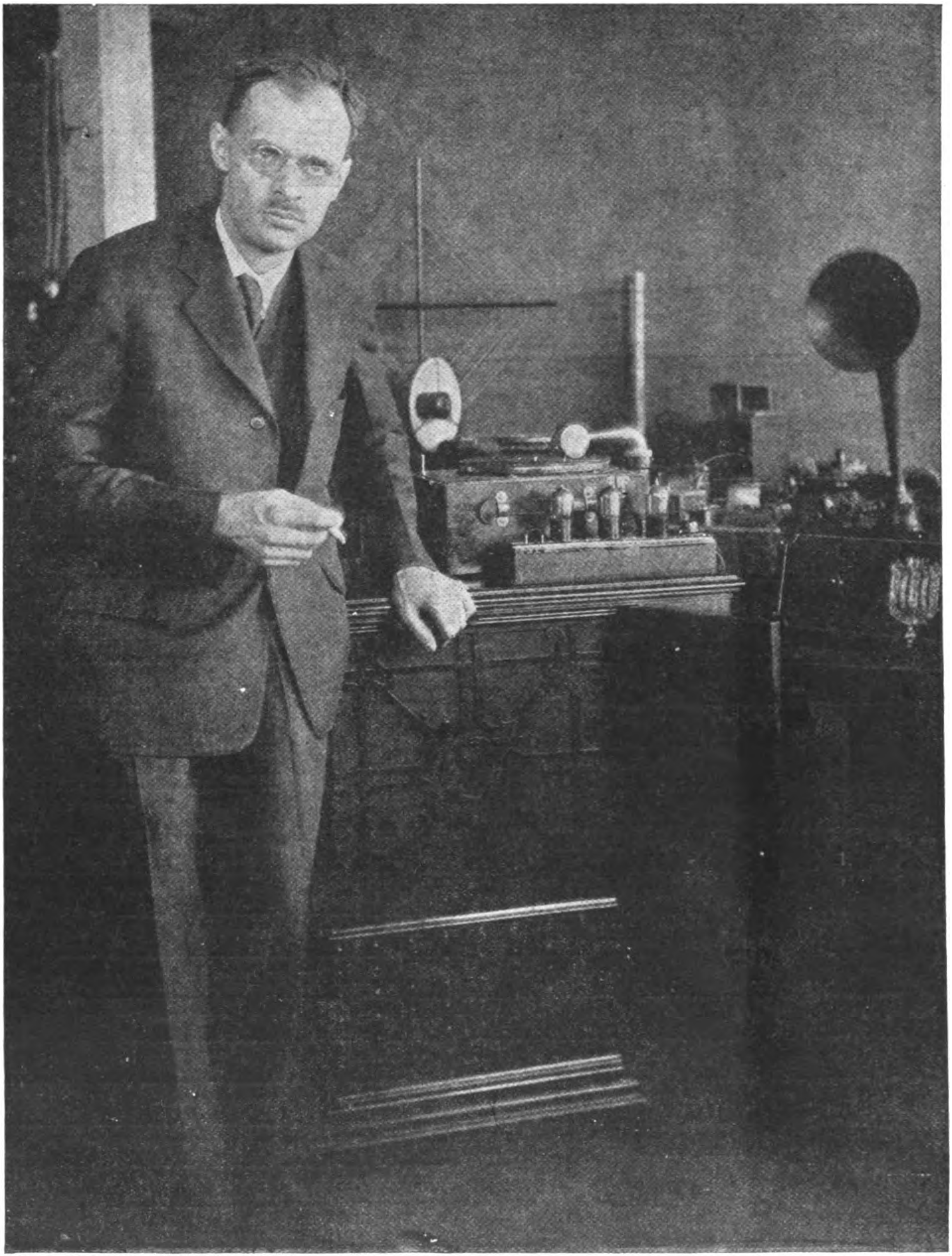
The RADIO ALMANAC

Notable Events and Anniversaries

August, 1927

● **Full Moon, 12th Day 1 h. 5 m., evening, E**

D.M.	D.W.		Notable Events and Anniversaries	
1	M.		1892: EDOUARD BRANLEY devised an appliance for detecting electromagnetic waves; it was known as a "coherer." *Rather warm!*	☼
2	Tu.		1907: The first paid press dispatches were sent across the Atlantic by radio. *Be sure that your lightning arrestor is in working order.*	
3	W.		1896: The first demonstration of directional wireless was given in England, with the aid of reflectors. *Hot spells and thunderstorms will mar distance radio reception during this month.*	
4	Th.		1903: First International Radiotelegraphic Conference was held in Berlin. 1903: VALDEMAR POULSEN patented the improved arc oscillation generator, using a hydrocarbon atmosphere and a magnetic field.	
5	Fr.	☽	1924: Station KDKA established communication with the ship *Arctic* within 11 degrees of the North Pole, thus establishing a record for farthest north reception.	
6	Sa.		1904: The first commercial business to be transacted by radio was conducted through the United States Signal Corps station in Alaska.	
7	S		1923: Radio broadcasting was first used as a paid advertising medium. 1922: The Sainte Assize radio station was opened. *Tune in on church services.*	
8	M.		1915: During this month F. A. KOLSTER maintained experimental work on his radio compass, which was more effective than any used up to that period.	
9	Tu.		1837: The first patent for an electric telegraph was taken out by COOKE and WHEATSTONE, of London, and by SAMUEL F. S. MORSE, of the United States. *Fair and warm.*	☼
10	W.		1888: RAYMOND A. HEISING, creator of the Heising system of modulating radio currents for radio broadcasting, was born. *Begin now to plan for the new radio receiver.*	
11	Th.		1923: A Federal Court ruled that the broadcasting of the song, "Mother Machree," copyright by M. Whitmark & Son, by Station WOR, owned by L. Bamberger & Co., constituted "a performance for profit."	
12	Fr.	○	1847: DR. O'SHAUGHNESSY succeeded in passing intelligible signals without metallic conduction across a river 4,200 feet wide.	
13	Sa..		1912: An act was approved by the United States to license radio operators and transmitting stations. *This is a good time to experiment with the new tubes.*	
14	S		1919: The first successful non-stop transatlantic flight of ALCOCK and BROWN, as well as the transatlantic flight of the British dirigible R34, pointed out the inestimable value of radio equipment in aviation work.	
15	M.		1904: The wireless telegraph act of Great Britain was passed. *About this time a new crop of "sure-fire static eliminators" will be announced.*	
16	Tu.		1884: STANFORD C. HOOPER was born. Among his inventions is the radio compass system now used in the United States Navy.	
17	W.		1827: SAVARY found that a steel needle could be magnetized by the discharge from a Leyden jar. *Bring the portable receiver along on the picnic!*	
18	Th.		1908: At about this period DR. REGINALD A. FESSENDEN reported successful radiophonic communication between his station at Brant Rock, Mass., and Washington, D. C.—a distance of 600 miles.	
19	Fr.	☾	1889: SIR JOSEPH J. THOMSON suggested that electric waves were particularly suitable for the transmission of signals through fogs and material objects.	
20	Sa.		*If all the users of interference-producing violet ray and other machines were laid end to end, they would form a line reaching from the prison at Sing Sing to the asylum at Matteawan—and it is suggested that they be laid that way.*	
21	S		1920: The first official radio message was transmitted from the Lafayette radio station at Bordeaux; it was addressed to the Secretary of the United States Navy. *Hot and muggy.*	☼
22	M.		1921: The first town in the United States to be named Radio (Virginia) was given to the community where the Arlington radio station is located.	
23	Tu.		1914: The Lackawanna Railroad conducted its first tests of radio reception on moving trains.	
24	W.		1907: During this month ARTHUR KORN, the German radio expert, began his experiments in the radio transmission of pictures, which later came into commercial use.	
25	Th.		1919: The Franklin Medal, awarded by the Franklin Institute of Pennsylvania, was this year given to Major General GEORGE O. SQUIER for his contributions to telephonic, telegraphic and radio communication systems.	
26	Fr.		1873: DR. LEE DE FOREST, inventor of the audion valve, was born. *Pep up your receiver occasionally with new valves.*	
27	Sa.	●	1910: The first successful American attempt at radio transmission from a plane in flight to a ground station took place at Sheepshead Bay, Long Island, N. Y.	
28	S		1843: LINDSAY suggested that if it were possible to provide stations not more than 20 miles apart across the Atlantic there would be no need of laying a cable.	
29	M.		1870: VON BEZOLD discovered that oscillations set up by a condenser discharge in a conductor gave rise to interference phenomena.	
30	Tu.		1921: The American Radio Relay League opened its first convention in Chicago.	
31	W.		1923: AUGUSTE GUSTAVE FERRIÉ, a general in the French army, was at about this time awarded the Franklin Medal "in recognition of his successful researches in the field of radio transmission of intelligence."	



From a photograph made for POPULAR RADIO

The Wedding of the Radio Receiver and the Talking Machine

One of the most important advances made in the field of radio during the past few months has been in low-frequency amplification. The new apparatus known as the "electrical pick-up" now makes possible this form of amplification of talking machine records. Mr. H. P. Donle (who developed one of the methods described in the article beginning on page 14) is best known as the inventor of the famous sodion detector tube and of the system of truphonic amplification.

Popular Radio

VOLUME XII July-August, 1927 NUMBER 1-2

THE NEW PROSPECTS OF TRANSMITTING

POWER BY RADIO

Years ago Nikola Tesla, imaginative genius of electrical engineering, predicted that power would one day be sent from place to place *without wires.* With each year the hope grows stronger. In this article Mr. Elway describes some remarkable experiments and predictions of power by radio recently presented at a gathering of scientists.

By THOMAS ELWAY

MEN have been dreaming for twenty years of sending power by radio. It is still a dream but it grows solider. Like Jules Verne's imagined submarine, it seems more and more apt to come true.

On a recent evening in New York City the staid and sober and matter-of-fact New York Electrical Society devoted one of its famous meetings to a discussion of the possibilities of radio power and to demonstrations of some of the things that already are realities.

Dr. Philips Thomas, Research Engineer of the Westinghouse Electric and Manufacturing Company, already well-known to the radio public through his invention a year or two ago of the "glow transmitter" microphone,* was one of the speakers. He painted a picture of what practical radio power might mean:

"We may visualize," he said, "a parallel beam of radiation ten centimeters or four inches across, along which is being sent ten kilowatts of energy. What sort of effects shall we find? Will this be a means of delivering energy for heat and light to individual houses? Tesla had a similar idea many years ago. Later improvements in the radio art make it interesting to consider such a possibility once more.

"We may imagine each house furnished with a half-wave oscillator in line with a parallel beam from a sending station, so that heat and light may be obtained very much as at present, by simply turning a switch, but without the costly transmission wire equipment now required."

What Dr. Thomas foresees, not as a certainty but at least as a possibility, are thousands of beams of radio power criss-crossing the roofs of a city or the farms of a countryside, like the beams of searchlights from a fleet of mighty battleships. He is thinking of power lines, carrying power as our great towers and wires do now, but which nobody will have to build because they will not be material structures. They will be created, when necessary, from the substance of the air itself and by the action of the same electric forces which it will be their duty to carry.

Dr. Thomas spoke first of the mere generation and use of radio waves concentrated into beams, something which he agrees with other engineers in believing quite possible so soon as we can generate waves of sufficiently short wave-length and in sufficient intensity. But that is not the only possibility nor the most significant one.

"Suppose," Dr. Thomas continued, "it should happen that this four-inch beam of highly concentrated energy should render conducting the air through which it passes. Then ordinary electric power could be sent along the beam as though the beam were a transmission line. The beam could be directed to any desired spot, with dire results to the target. It would constitute the so-called 'heat ray' employed with such deadly effect by the Martians in H. G. Wells' well-known story of their descent on earth."

This is no mere empty imagining. Granted that it will probably prove possible to make the short-wave radio beams at all, it is more than probable that they could be made to render the air at least partially conducting for other varieties of electric current, possibly even for direct current although the familiar sixty-cycle alternating current is perhaps somewhat more likely.

Such power-carrying beams of conducting air would probably be self-luminous, shining with the same clear bluish light which every radio amateur has seen once in a while in soft transmitting tubes and which is called the "blue glow." Probably the light produced would not be bright enough for any use. Otherwise one might imagine a beam of the rays passing down the center of the street, its own glow serving for the street lighting while it carried power to the subscribers along the route. It would be as though the power wires were themselves white-hot all the time and lit the streets without any lamps being necessary.

---

* "The Remarkable New 'Glow' Transmitter," by David Lay. POPULAR RADIO for April, 1923, pages 290-294.

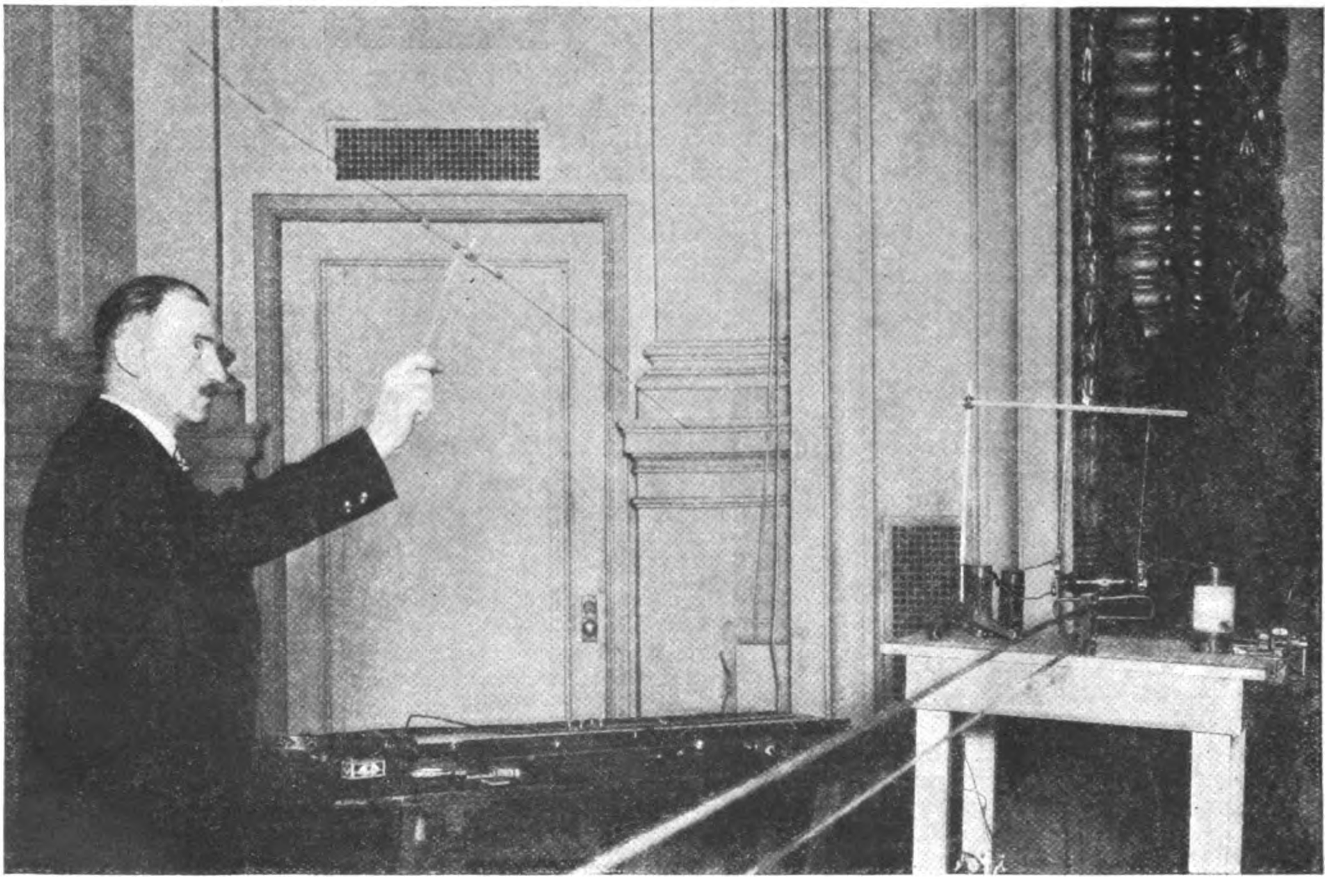
This is probably too much even for a Jules Verne to hope for in the near future, but the glow of Dr. Thomas's imagined radio power beams would be a considerable advantage in another way. If such beams are ever used they will not be pleasant things to run into unexpectedly. Their effects would probably be not unlike those predicted by Mr. Grindell-Matthews and others for the various varieties of "Death Ray" that have been conceived and proposed. Power rays criss-crossing the housetops would have to be high enough above them so that careless radio fans, fixing antennas on dark winter nights, could not thrust either the antenna pole or an incautious head into the powerful and destructive beam. If the beam were utterly invisible, the danger would be greater than if it glowed dimly, as it is probable that it would.

Dr. Thomas did not predict, nor is it probable, that beams of this kind would be used at first in distributing power in cities or for any similar purpose. Wires work very well for such duties, and there would be no object in displacing them. On the contrary, the first use of the radio power beams, if they become possible at all, will probably be in places and under circumstances which render wires unsatisfactory.

An example which Dr. Thomas cited to the Electrical Society is that of a contractor who finds it necessary to take electric power up the side of a mountain or to some similarly inaccessible spot to begin digging a tunnel or preparing for a bridge or carrying out some other engineering work. Wires may be hard to place and to maintain. Perhaps the operation is a temporary or a movable one, so that the wire installation would be no more than installed until it would be necessary to remove it again, the removal being almost as difficult as the installation.

Such situations would be opportunities for radio power. Imagine a beam-forming transmitter, perhaps mounted on a motor truck or a boat, and easy to set up and operate at some accessible point near the mountain-side which must be fed with power. The contractor wheels his beam-gun into position, starts his oscillator, trains the ray on the spot desired and turns on the power. With no more trouble than he has now with the light rays of his searchlights for night work, he carries the needed electric power to any peak or cliff where his men must cling precariously to do the job the engineers have set.

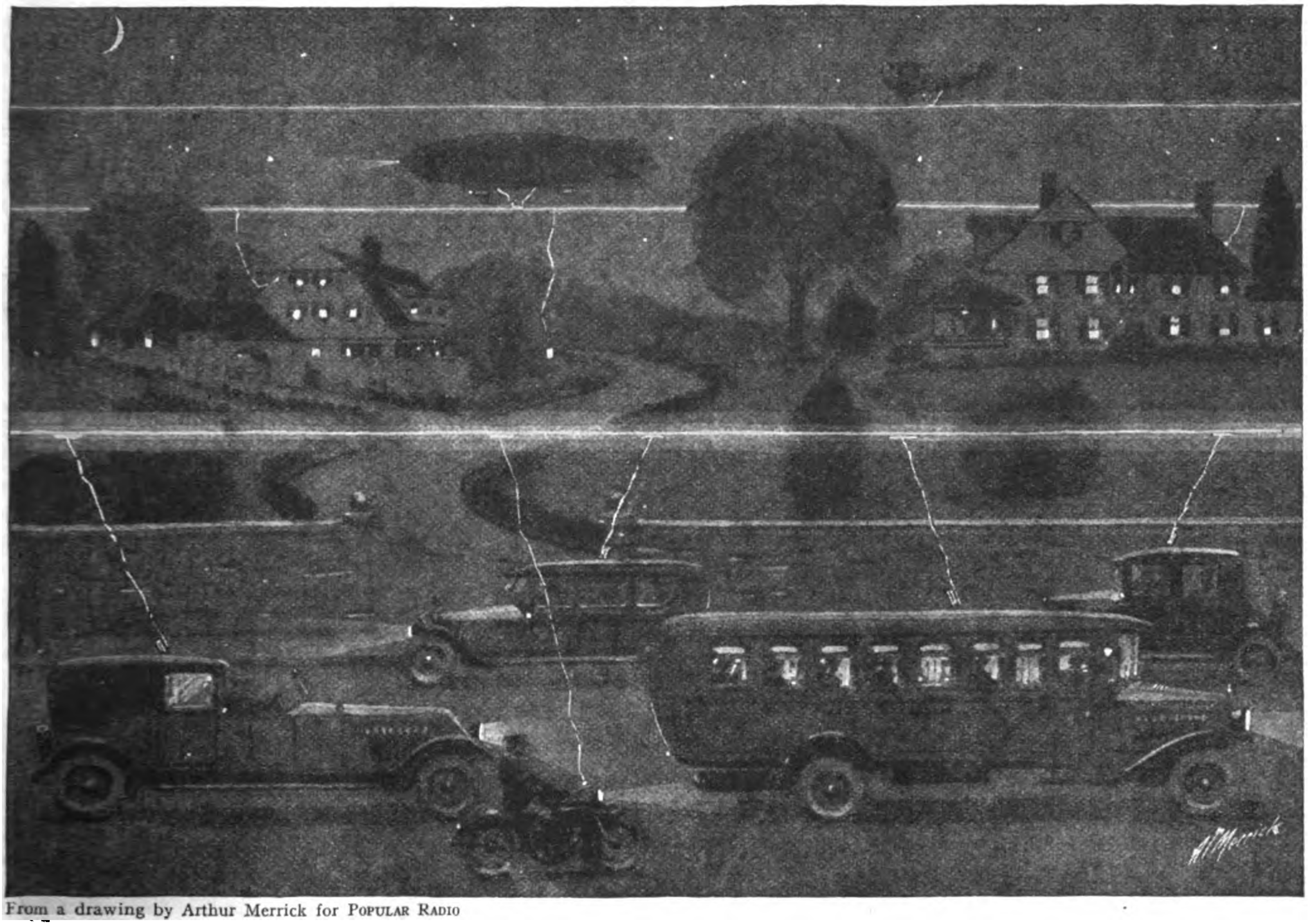
There are probably uses for the power-carrying radio ray, also, in crossing rivers or harbors where wires are impossible or difficult to place. The span which can be bridged by any reasonable



New York Electrical Society

How Dr. Thomas Pulled Radio Power Out of the Air

The vacuum-tube oscillator mounted on the table at the right produced radio waves of 2.4 meters wavelength. These filled the surrounding space. By holding in this radio field a stiff copper wire one-half wavelength long, operating as a Hertz antenna, Dr. Thomas picked up enough radio energy to make the small lamp at the center of the antenna glow brilliantly. The lamp glowed only when the copper wire pointed in the proper direction, thus proving that the waves were partly polarized, as are the waves now used in short-waved broadcasting. The flat aluminum ribbons were used instead of ordinary wire for the Lecher wires in the foreground, so that these were visible to the audience, a device which other lecturers using such wires will doubtless hasten to imitate.



From a drawing by Arthur Merrick for POPULAR RADIO

When Power Is Drawn from Shining Radio Beams

In the future of radio power, which Dr. Thomas visualizes, power for automobiles, for dirigibles and airplanes, for households, and for many other purposes, may be carried by self-luminous beams of radio waves. Such concentrated radio beams might render the air conductive, so that ordinary power could pass along these beams as it now passes along wires.

variety of power wire is not unlimited. To put high-tension power cables under the ground or beneath the waters of a river or estuary is an expensive task at best and is not always a possible one. A tower on one side of the barrier with a set of generators for powerful radio beams; a receiving tower on the other side similarly equipped, both raised well above any danger to passing vessels from the beam, and the trick would be turned. Possibly something of this kind, to solve many such problems which now puzzle the power engineers here and there in the world, would be the first practical use of power by radio if it becomes an actuality.

There are possibilities, also, in radio power transmission over relatively short distances near great powerhouses and around power-producing machinery. Sometimes enormous amounts of power have to be carried between bus bars or from the terminals of a dynamo or other machine to some other piece of apparatus. Massive bars or sheets of copper or aluminum are now used for such purposes. They work well enough, but perhaps a beam of conducting air would be better. At least it would have the advantage of not burning out so readily as copper. Even if the air did "burn," more air is cheap and no harm would be done.

All these possibilities depend, of course, upon just what the properties of the imagined radio beams will be if they are produced. It is possible, as Dr. Thomas told the Society, to predict some of these properties.

The chief secret of producing the imagined beams will probably lie, Dr. Thomas said, in generating very short radio waves at very high power.

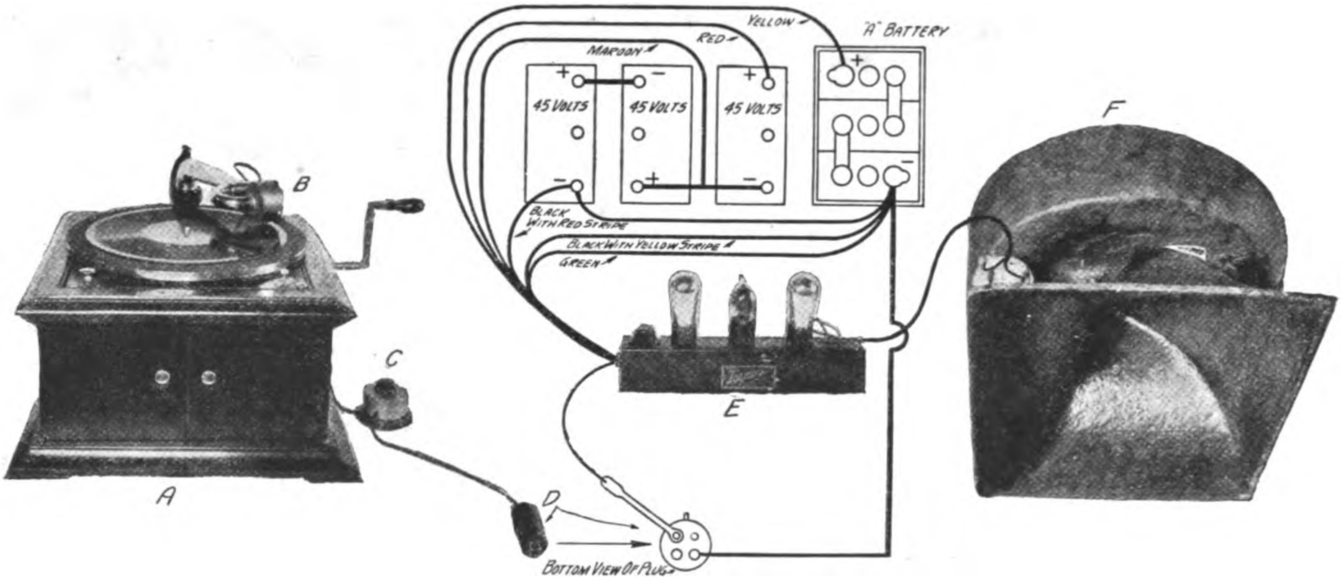
Short radio waves, even as short as a few centimeters in wavelength, are no novelty. Some of the first waves produced by Professor Heinrich Hertz, when he still did not know that he had discovered radio, were extremely short ones, although badly mixed, as we know now, with waves of many other wavelengths. The writer of these lines constructed, just thirty-one years ago, a spark-coil and wave receiver that produced and received some of these then-mysterious sparks which Dr. Hertz was so excited about.

Quite early in these private experiments the electric-light transformer on the outside of the house unaccountably burnt up; producing a gorgeous spectacle, the volunteer fire department and a great black smudge on the side of the house. At the earnest solicitation of the electric light company, the fire department and the family, the experiments were discontinued. But not until they had proved—as did the more skillful experiments of a thousand other amateurs and professionals all over the world—that what we now know as short radio waves are easy to produce.

Unfortunately, however, all of the generators for very short waves, including Hertz's spark-gap and every device since produced, show themselves strictly limited in power production. A few watts output is possible enough. More than a few watts is not possible unless one is content to increase the wavelength.

Working with special vacuum tubes and with an oscillating circuit of his own design, Dr. Thomas has been able to produce radio waves as short as 2.4

(*Continued on page 74*)



HOW THE NEW UNITS ARE CONNECTED TO A STANDARD PHONOGRAPH

FIGURE 1: *The various instruments and parts shown in this pictorial diagram are designated by letters that reappear in the list of parts given below. This arrangement gives remarkably clear and realistic reproduction from a phonograph record.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any old phonograph;
B, C and D—Warford reproducer, comprising pick-up, control unit and plug;
E—Truphonic power amplifier, comprising three stages of low-frequency coupling, No. 304;
F—Donle cabinet reproducer;
3 45-volt "B" batteries;
1 6-volt "A" battery;
1 UX-201-a type valve;
1 Donle High Mu valve;
1 UX-112 type valve.

How to Add the New Radio Amplification Units to Your Phonograph

The new "electrical pick-up" that gives reproduction to talking-machine records in better quality and greater volume than has ever before been possible.

If you already have a radio receiver and a phonograph (any type with a turn-table in running order will serve), all the new apparatus you need for hooking them up together is the newly invented electrical pick-up device that costs from $10 to $20; if you *don't* own a receiver, the same effects may be attained through a reproducer and amplifier—which will cost altogether from $40 up to $125. Demonstrations have shown that this invention gives better reproduction than has ever before been attainable.

By LAURENCE M. COCKADAY

HAVE you an old talking machine about the house? Or perhaps it's at your camp or summer cottage.

If you have one, there's a surprise and a real treat in store for you.

If by chance you haven't, you can pick one up for a song, both literally and figuratively speaking. For it is estimated that there are more than 14,000,000 old-type talking machines in the United States, most of them at the present time dumb, idle and scorned, with very little quick cash value. The simplest form of machine will do; all it really needs to have left is a smoothly running turn-table.

The old talking machine passed out of the picture for two reasons:

First, because radio flashed in with its novelty, its range of entertainment and improved quality of reproduction.

Second, because the principles of radio were later applied to the talking machine itself.

The new-style machine is now very justly climbing in popularity, for the reason that the same principles of vacuum-valve amplification of sound frequencies employed in radio have been applied to the talking machine itself and have so improved its reproduction that it sounds as good as a first-class radio receiver. This is exemplified, for example, in the Victor Orthophonic and Brunswick Panatrope.

Another advance is shown in the advent of the large "exponential" horn-type reproducer. (See page 22 of this issue of POPULAR RADIO.) This type of loudspeaker successfully handles greatly increased volume and brings out the low notes as the old talking machine never could. And still another improvement is in the records themselves. They, too, have gained by the application of radio principles, being made by an electrical amplification process.

And now it has become a simple matter for you to adopt these great improvements, apply them very easily to that old talking machine and convert it into an ultra-modern device that will produce music in marvelous tones, with a volume subject to control and ranging from the faint whisper of a violin to the rich swell of a great organ.

All this you can do with that old cast-aside talking machine, with the expenditure of a very little money, no mechanical skill, and almost no time. You may do this somewhat progressively, if you wish to convince yourself of the unique functions and marked advances represented by each mechanical part.

The complete assembly may be divided into three parts, or divisions:

1. The electrical pick-up unit;
2. The power amplifier;
3. The new type of exponential horn.

In Figure 1 is shown a complete hook-up of these three new devices in connection with an old-style talking machine. (Other hook-ups are shown in Figures 4, 5 and 6.)

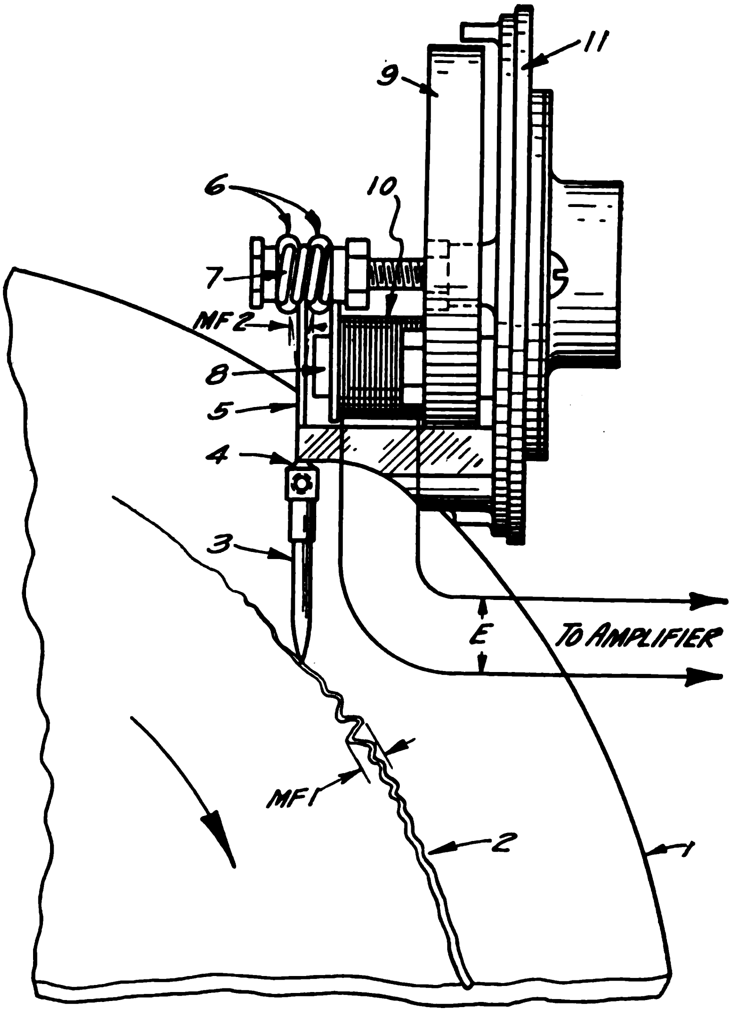
This combination produces a reproduction from the new electric records (such, for example, as the Victor, Columbia, Brunswick or Okeh types) that is an absolute revelation in tone quality—and perfection of lifelike reproduction.

At A in this diagram is shown the old-style talking machine, while at B is the electrical pick-up unit fastened onto the tone arm in place of the old-style mechanical sound box.

The volume control, C, and a plug, D, are part of the equipment furnished with the electrical pick-up device as a single unit; they are connected by a long, flexible cord that carries the current generated in the pick-up device, B, to the plug, D, and to the amplifier, E.

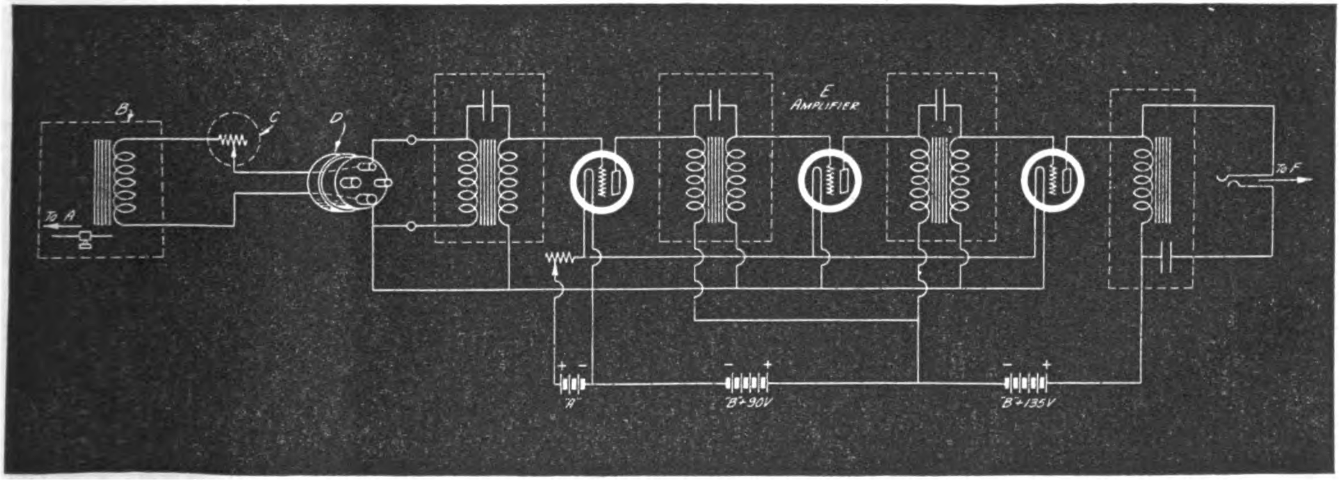
The diagram shown in Figure 3 also shows the proper connection from the plug to the amplifier, E, and to the three "B" batteries and the one storage battery required.

The new type of loudspeaker, F, may be obtained in a beautifully finished cabinet, but in the diagram in Figure 2 only the reproducer itself is shown in its crude, unfinished form, that you may get a better idea of its design. The cord is



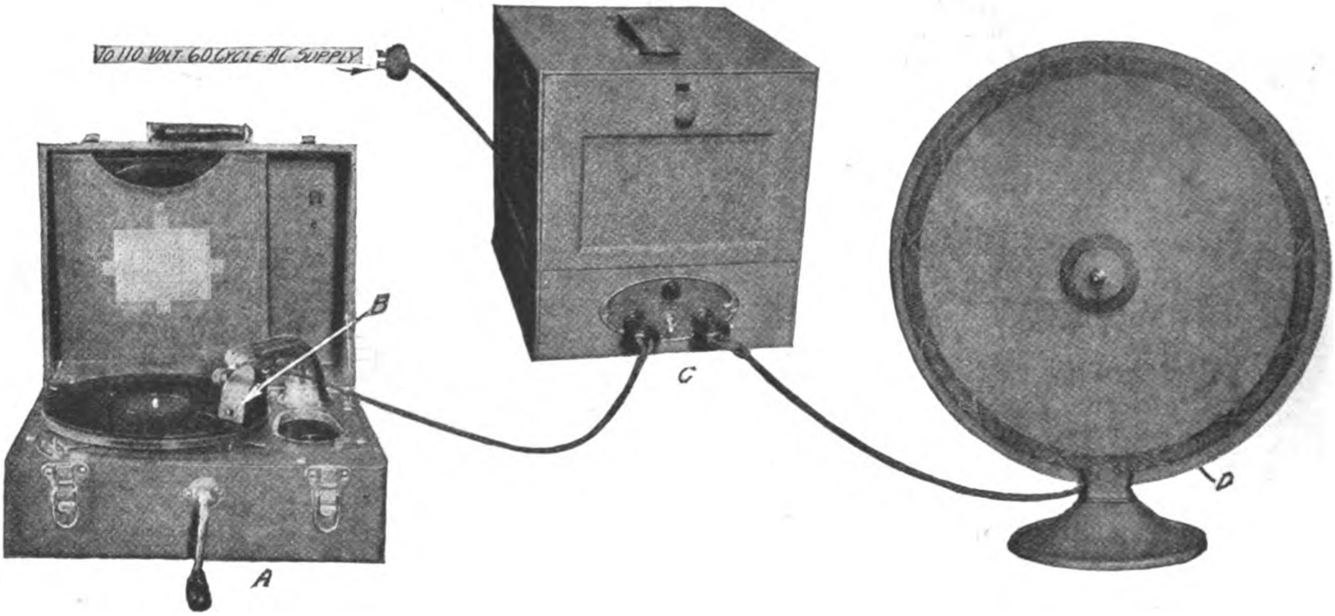
HOW THE ELECTRICAL PICK-UP WORKS

FIGURE 2: *The needle, 3, to which is attached the vibrating armature, 5, follows the vibrations imprinted in the record. The vibration of the armature generates a current of electricity in the magnet, 10, which furnishes a voltage, E, corresponding exactly to the vibration, 2, on the record, 1. This voltage, E, is then introduced in a standard low-frequency amplifier such as used in the better radio sets and is reproduced with a high quality reproducer of the cone or horn type.*



HOW THE AMPLIFIER IS CONNECTED TO THE ELECTRICAL PICK-UP

FIGURE 3: *This drawing shows the theoretical diagram of a "pick-up" connected to the Truphonic amplifier, E, shown in Figure 1. The volume control, C, is shown in series, although in most devices it is connected in shunt across the first amplifying transformer. It will be noted that the amplifier circuit is exactly the same as that used in radio receivers, and it is this arrangement that accomplishes the astonishing results that may be attained.*

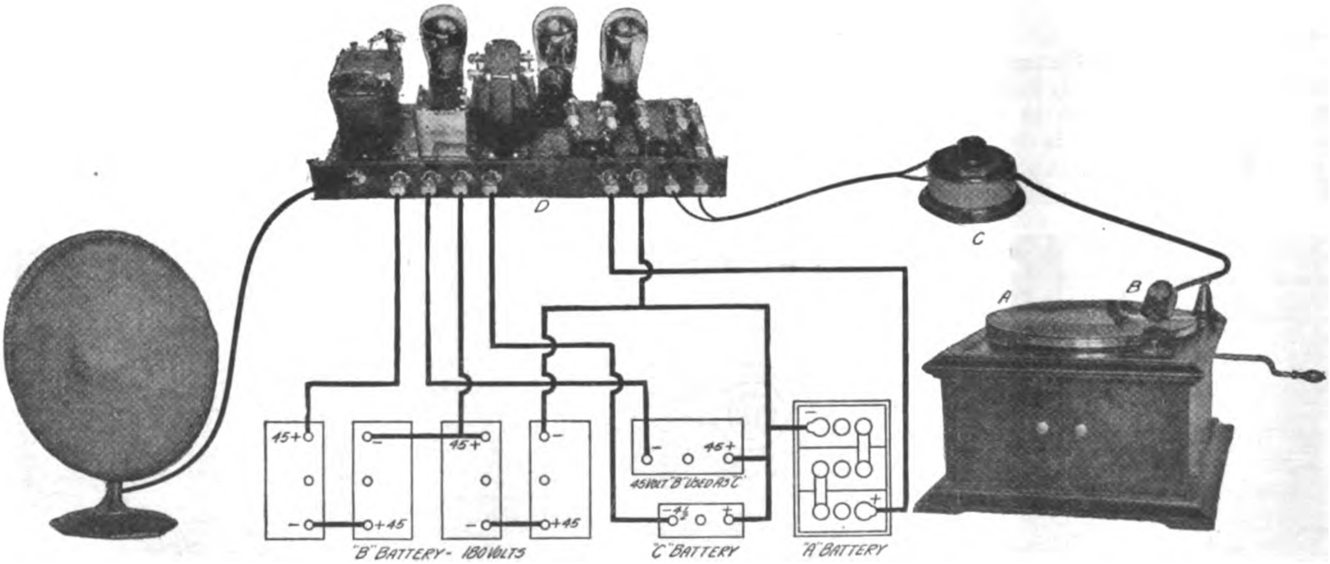


ANOTHER MATCHED COMBINATION OF UNITS THAT WORKS WITHOUT THE USE OF BATTERIES

FIGURE 4: *Here is shown, at A, a portable phonograph with an electrical "pick-up," B, attached to a complete two-stage amplifier and power-pack, C. A high quality cone reproducer, C, is plugged into the power-pack amplifier. A plug is furnished with the power-pack amplifier that connects directly to the 110-volt, 60-cycle AC lighting lines.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any old phonograph;
B—Pacent Phonovox electrical pick-up;
C—Special Pacent two-stage Powerformer, using UX-199 type valve in the first stage and a UX-210 type valve in the last stage;
D—Pacent 18-inch standard cone-type reproducer.

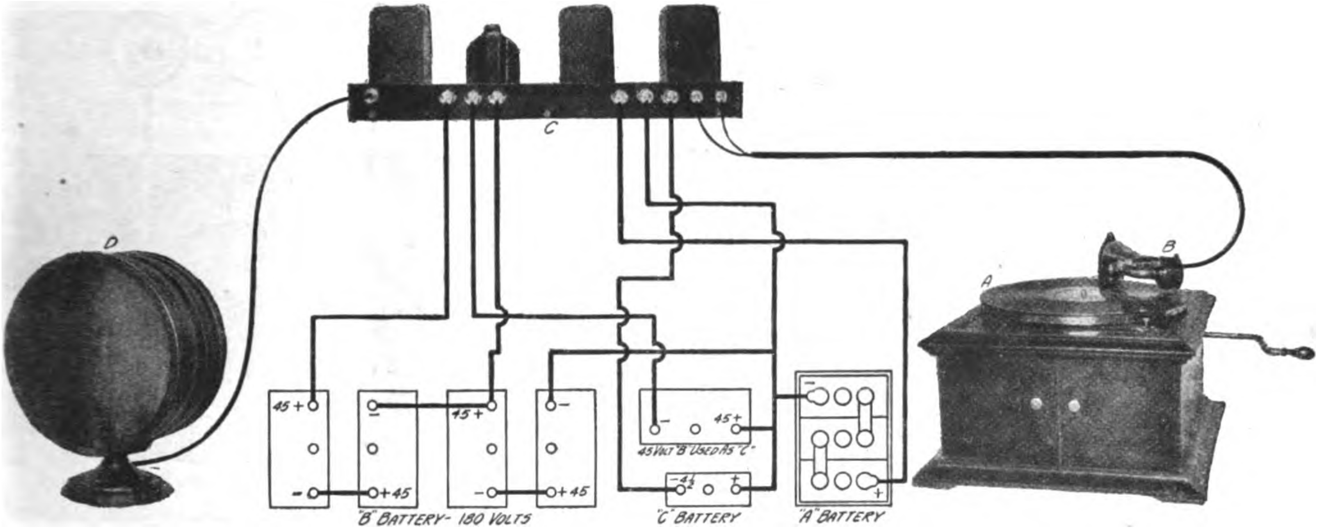


A MATCHED COMBINATION THAT USES RESISTANCE COUPLING AND TRANSFORMER COUPLING

FIGURE 5: *With this combination, that works on batteries and utilizes two standard UX-201-a valves in the first and second stages and a UX-171 type valve in the last stage, really fine results may be obtained from any phonograph. The construction of the amplifier, D, is fully described elsewhere in this issue. The list of parts for this combination is given below.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any old phonograph may be used here;
B—Bosch electrical pick-up;
C—Bosch volume control;
D—Quality amplifier (described on page 25 of this issue of POPULAR RADIO);
1 18-inch Western Electric cone reproducer, type 540-AW.



ANOTHER MATCHED COMBINATION THAT EMPLOYS DOUBLE-IMPEDANCE COUPLING AND TRANSFORMER COUPLING

FIGURE 6: *This combination, which uses the parts listed below, gives exceptionally fine quality and brings out both the high and low notes. The amplifier, C, uses two UX-201-a type valves and a UX-171 type valve in the last stage of amplification.*

HERE IS A LIST OF THE APPARATUS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any phonograph;
B—Alden electrical pick-up equipped with volume control;
C—High quality amplifier, described in the June, 1927, issue of POPULAR RADIO;
D—Temple reproducer.

attached from the reproducer unit to the output terminals of the amplifier, E.

This particular combination of apparatus is due to the research work of Mr. H. P. Donle, the well-known radio and vacuum-valve expert, who has been working on this problem for a number of years.

The exact electrical connections for the pick-up device and the amplifier itself is shown in Figure 1. A study of this system will reveal the fact that any electrical impulses generated by the pick-up unit, B, travel along the wires to the control unit, C, by which the volume may be raised or lowered, to the plug, D, and from there on a standard three-stage Truphonic-coupled amplifier is employed. From this same point it will be noticed that exactly the same methods are used in this case to improve the phonograph as have been developed so successfully during the last year to make radio reproduction so faithful.

It will be of interest to study the method used in the pick-up device to convert the mechanical vibrations as obtained from the record into an electrical impulse that can be amplified by radio methods and finally reproduced by a radio loudspeaker.

Figure 2 is a sketch of the electrical pick-up unit that must be used to accomplish this purpose.

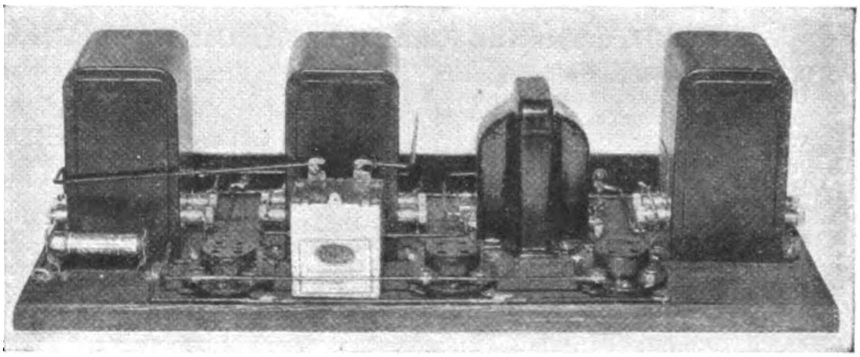
A cut-away section of a record is shown at (1) with the recording impulses designated at (2). The needle, 3, travels in this winding path and thus is supplied with a motive force, MF1, which is transmitted through a bearing, 4, to a vibrating magnetic reed, 5. As the needle, 3, vibrates, the reed, 5, is also activated and vibrates in accordance with the amplitude of the motive force, MF2. This reed is dampened by two special rubber dampeners, 6, and held by a spring tension device, 7. Adjacent to the reed, 5, is a magnetic pole piece, 8, upon which is wound a coil of wire, 10. The magnet, 9, is fastened to the pole piece, 8, and the whole unit is mounted upon the framework, 11.

As the reed, 5, vibrates, it varies the gap between the reed and the pole piece, 8, thus changing the magnetic flux flowing through the magnet, 9, and generating an electrical impulse, E, in the coil, 10. This electrical impulse, E, varies in strength or amplitude in exact accordance with the curves in the record and the force, MF1, applied to the needle, 3, and in turn to the reed, 5. The electrical impulse, as stated before, is then applied to the amplifier, E (Figure 1), through the variable-resistance control, C, and the plug, D.

Any kind of old-style talking machine that has a workable turn-table and a tone arm may be used with exactly the same results, as the only items that affect the tone quality and volume are the type of record used, the pick-up device, the amplifier and the reproducer.

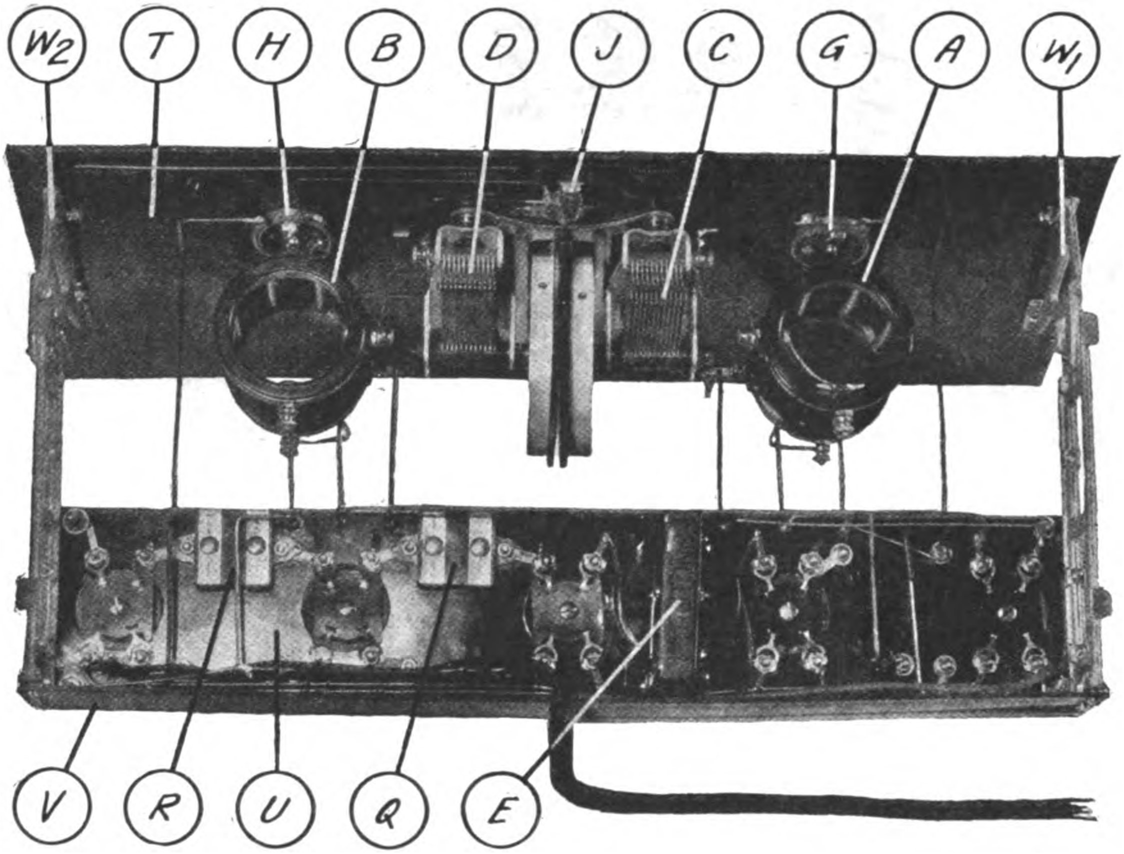
The complete device may be used, too, with any good radio set and reproducer by merely placing the plug, D, in the detector socket of such a set. But in

(*Continued on page 72*)



A CLOSE-UP OF THE AMPLIFIER SHOWN IN FIGURE 6

FIGURE 7: *This unit, which is simple to build, uses two double-impedance coupling units, a high-quality transformer and an output filter. (The constructional data of this device was given complete in the June issue of* POPULAR RADIO.)



VIEW OF THE SET FROM BELOW

FIGURE 1: *Here is shown the general arrangement of the apparatus mounted on the strip and on the front panel. The mounting of the instruments is greatly facilitated by the sectional assembly.*

HOW TO ASSEMBLE THE

New Unitune Receiver

This is the third of a series of articles on the assembly and operation of popular kits of parts that may be obtained for building really good radio receivers; they differ from the "How-to-Build" articles, in that the sets described have been designed outside of POPULAR RADIO EXPERIMENTAL LABORATORY by commercial engineers. The sets that are selected for description have been carefully tested in the POPULAR RADIO ELECTRICAL TESTING LABORATORY and will be chosen for their outstanding features and all-around efficiency.

By JOSEPH CALCATERRA

COST OF PARTS: *Not more than $54.51*

HERE ARE THE PARTS THAT ARE USED IN THE NEW UNITUNE RECEIVER—

A, B, C and D—Bruno high-frequency Unitune assembly unit consisting of an antenna coil, coupling coil and two variable condensers, .00035 mfd.;
E—Bruno low-frequency transformer, type D;
F1, F2, F3, F4 and F5—Pacent subpanel mounting sockets;
G and H—Carter midget rheostats, 20 ohms, type No. M-20;
I—Amperite No. 3A (for 112 or 171 type tube in last stage use Amperite No. 1);
J—Bruno light switch;
K—Electrad grid condenser with grid-leak clips, .00025 mfd., type GS;
L—Durham metallized resistor, 2 megohms;
M—Durham metallized resistor, .1 megohm;
N—Durham metallized resistor, 1 megohm;
O—Durham metallized resistor, .1 megohm;
P—Durham metallized resistor, .5 megohm;
Q and R—Electrad fixed condensers, .006 mfd., type P;
S1, S2, S3 and S4—Eby engraved binding posts marked "ANT," "GND," "SPEAKER —" and "SPEAKER +," respectively;
T—Westinghouse Micarta front panel, 7 by 18 by 1/8 inch;
U—Westinghouse Micarta subpanel, 7 by 17 by 3/32 inch;
V—Westinghouse Micarta back strip, 1½ by 17 by 3/32 inch;
W—Bruno adjustable brackets.

SO intent have some radio engineers been to get the ultimate efficiency out of a receiving circuit that they have lost sight of the average radio listener who looks upon a radio receiver merely as a means of furnishing him with good reception at a minimum of cost and with a minimum expenditure of effort.

Just a short time ago, reports of the motor speed tests conducted on Major Seagrave's "mystery racer" filled the columns of the daily papers and Sunday supplements. In these tests a speed of 207 miles an hour was attained by the racer, breaking all previous speed records for a land-going vehicle. While these tests were interesting, few orders were received for this type of car. Most of us are content to jog along at the comfortable ordinary speeds prescribed by law.

No one questions that many laboratory and high-grade commercial radio receivers will do wonders in the way of distance reception through a heavy barrage of local interference. This type of reception, however, requires a considerable outlay of both time and money in the building of a receiver. Like the 80 and 90 mile-an-hour cars of commercial manufacture, such efficiency can only be produced at considerable expense.

The designers of the Unitune receiver were not primarily interested in producing a receiver exclusively for stunt reception. Rather, they worked to design a set having the following features:

1. Selectivity capable of tuning in local stations without interference;
2. Low cost of construction;
3. Good tone quality;
4. Suitable volume control without loss of quality;
5. Adaptability to all antenna sizes;
6. Simplified construction.
7. Ease in tuning.

The circuit itself is of the simplest possible type. It belong to the class of circuits which may always be depended upon to work when the last connection is made and the vacuum valves, batteries, reproducer, and antenna and ground leads are connected to the proper terminals. It requires no coaxing, no delicate adjustments, no hairline tuning.

The circuit calls for five vacuum valves. It consists of one stage of tuned high-frequency amplification; a tuned detector stage without regeneration to preserve best tone quality; a stage of transformer-coupled, low-frequency amplification and two stages of resistance-coupled, low-frequency amplification.

The circuit is designed for operation with UX-201-a type valves throughout. For greater sensitivity, UX-200-a type detector valve may be used. If that type of valve is employed, the grid return from the detector stage should be connected with the negative filament terminal of the detector socket instead of with the positive filament terminal. Figure 4 gives the wiring diagram of the receiver.

A UX-112 type valve may be used to advantage in the last low-frequency stage. In that case it is desirable to use a 9-volt "C" battery in the grid return lead of the last stage.

A voltage of 22½ to 45 volts should be used in the plate circuit of the detector. The "B+Amp" terminal should be connected with the 135-volt terminal of the "B" battery. A lower voltage will not give good results with resistance-coupled amplification.

Two rheostat controls are employed. The rheostat G (see Figure 1) serves to adjust the high-frequency vacuum valve filament for sensitivity and volume.

The rheostat H is used to adjust the detector valve for most efficient operation.

An automatic filament control is employed for adjusting the filaments of the three low-frequency valves. A No. 3 type amperite should be used when all three valves are of the UX-201-a type. Three of these tubes require ¾-ampere at 5 volts. If a UX-112 or UX-171 type valve is used in the last stage, a No. 1 amperite, designed to pass one ampere at 5 volts should be used to take care of the extra quarter ampere.

A light-switch, combining the functions of battery switch and pilot light, is used to make and break the "A" battery circuit.

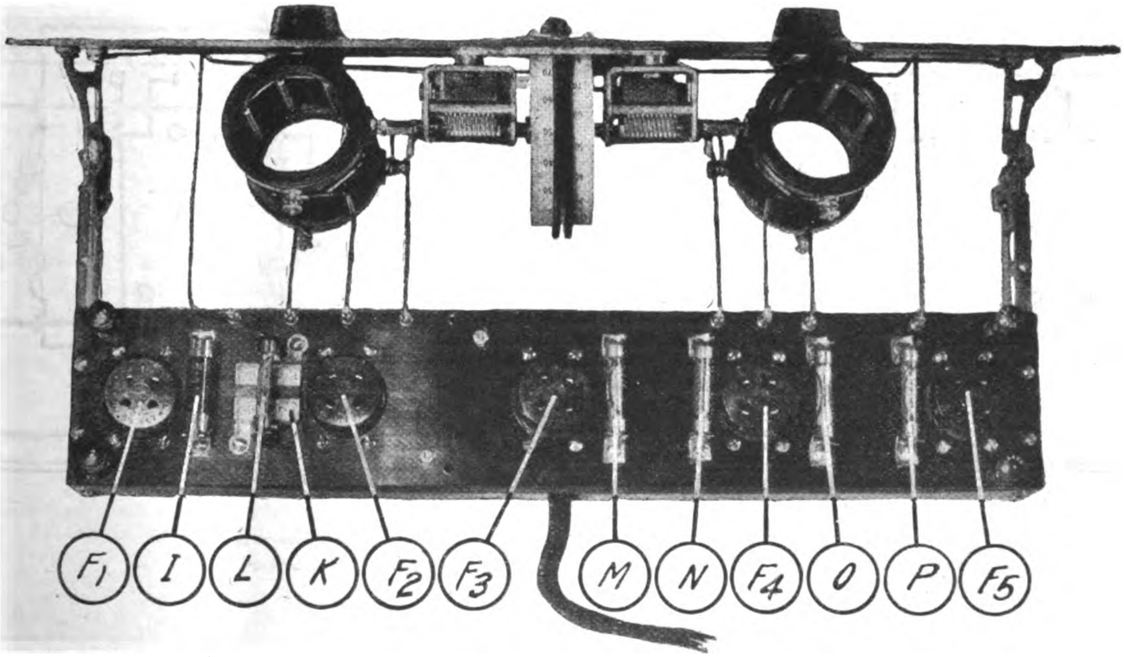
The Unitune tuner which is used as the basis of this circuit combines in a single, easily mounted assembly, two variable condensers and two tuned-high-frequency transformers. The whole assembly, together with the drum controls and panel plate, can be mounted on the front panel with two mounting screws. This unit simplifies the construction of the receiver and its operation.

The drum controls are arranged so that they can be moved by simply pressing on them together, or separately.

How to Assemble the Receiver

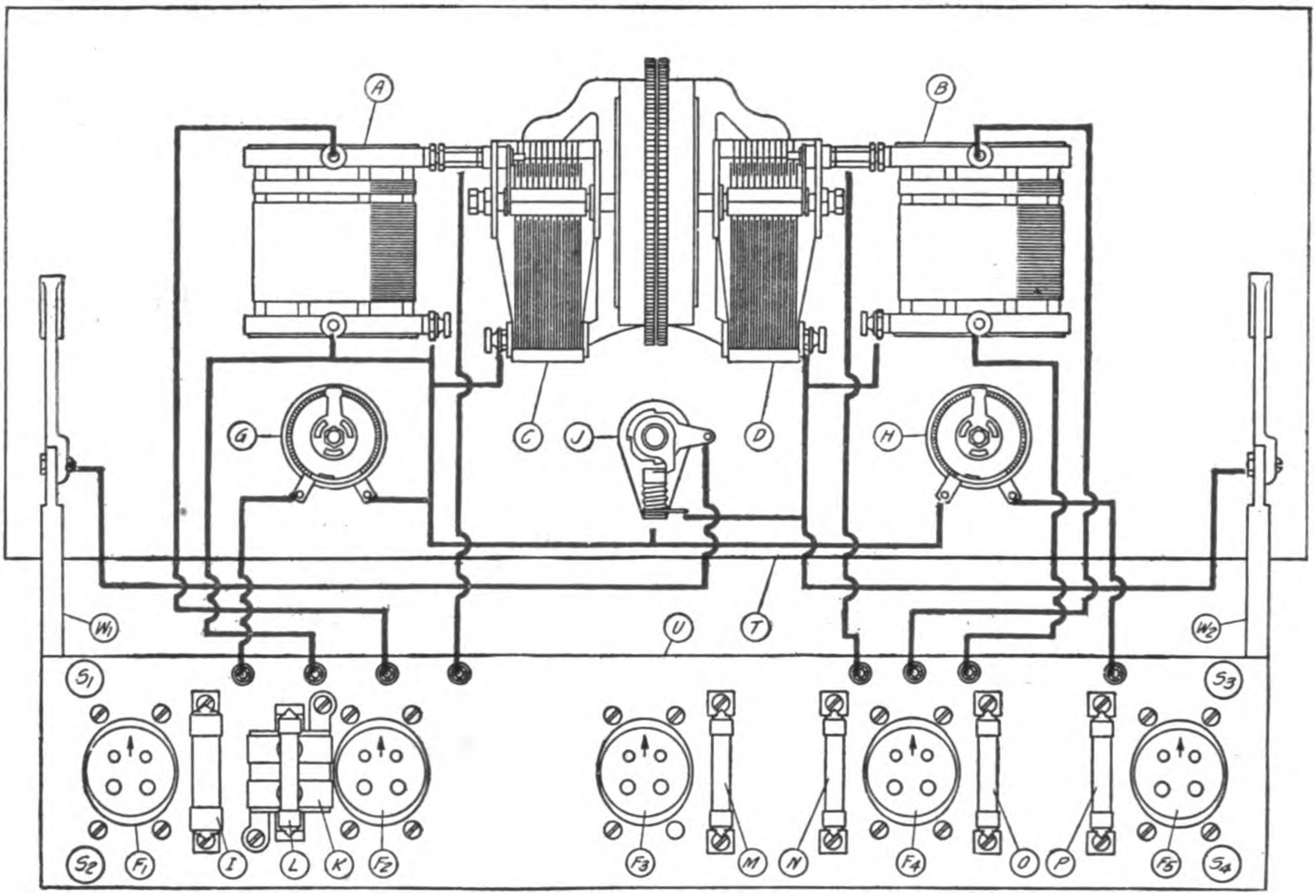
The construction of the receiver has been simplified by an ingenious method which permits the parts on the panel to be mounted and wired as one unit, and the parts on the subpanel to be mounted and wired as a separate unit.

Anchor studs are provided on the subpanel; the subpanel wiring is connected to these studs. Later the front panel and subpanel are mounted together and the wiring completed by running con-



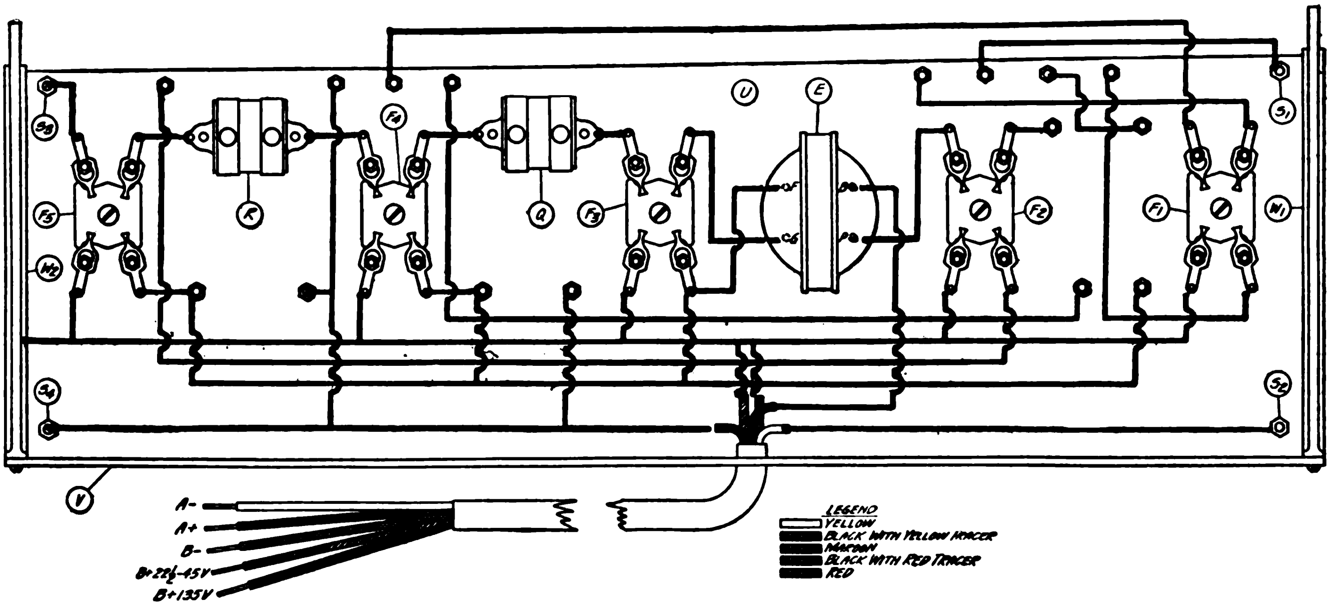
THE TOP VIEW OF THE RECEIVER

FIGURE 2: *This photograph gives the reversed picture of the set as that shown in Figure 1. An examination of these two illustrations will show that all the wiring is done on the bottom side of the mounting strip, U.*



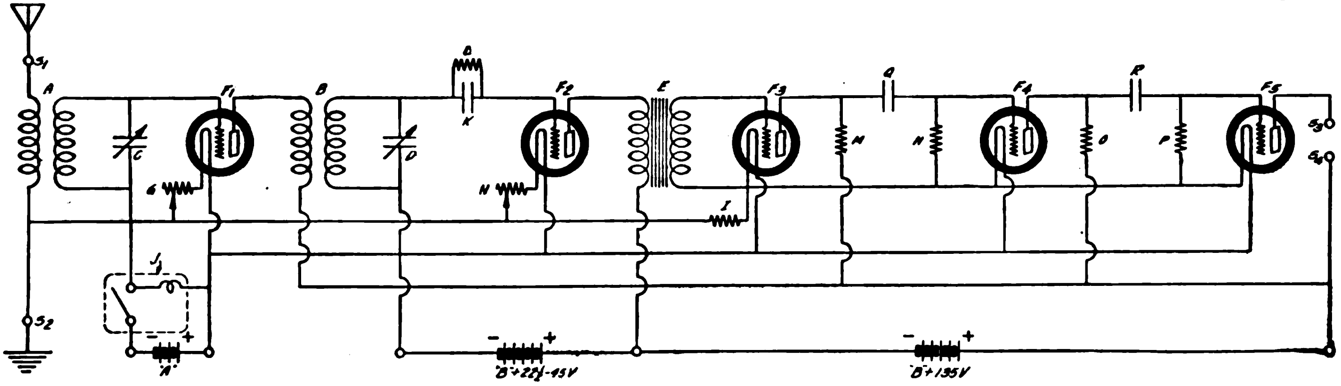
PART I OF THE PICTURE WIRING DIAGRAM

FIGURE 3: *Here is shown the wiring of the instruments on the panel, T, as the set is viewed from above. The wiring itself is shown in colored lines, while the instruments are outlined in black. The rest of the wiring is shown in Figure 4.*



PART II OF THE PICTURE WIRING DIAGRAM

FIGURE 4: *This drawing shows the wiring done on the underneath side of the mounting strip subpanel, U. The heavy colored lines show the connections that are made on the underneath side of this panel to the instruments mounted on it and to the connection cable. The instruments are outlined in black lines. The proper connections to the batteries from the cable itself are also indicated.*



THE THEORETICAL DIAGRAM OF THE ELECTRICAL CIRCUIT

Figure 5: *Here is given the proper hook-up for the various parts that go into the electrical circuit. One stage of high-frequency amplification with a vacuum-valve detector, one stage of transformer coupling and two stages of resistance-coupled amplification are used.*

nections between the anchor studs mentioned and the terminals on the front panel.

The mounting of the parts on the panel and subpanel is a simple procedure and no detailed explanation of this part of the job is necessary. Merely mount the parts in the positions shown in Figures 1 and 2. There are no critical positions for the parts.

In wiring the parts, first connect all the "G" and "P" terminals of the sockets, transformers, condensers and coils as shown in the wiring diagram in Figure 4. Make the connections as short as possible, running them in straight lines from point to point so as to avoid parallel wires.

You can then proceed to wire up all the other terminals, covering the wires with spaghetti wherever necessary when they cross each other or come in close proximity to metal parts.

After the two units are completely wired, assemble the panel and subpanel units and connect the remaining terminals.

The metal brackets can be used as connecting pieces. One of the brackets is used to make the connection between the positive "A" battery lead and the light terminal of the battery-switch. The other bracket is utilized to make the connection between switch and ground terminals.

The terminals of the battery cable are connected directly with the leads on the set so that the only binding posts necessary are the ground; antenna and the two reproducer terminals.

At the battery end, the wires should be tagged with markers to avoid any possibility of mistakes in connecting up the set. If a "C" battery is used for the last stage, the positive terminal of the "C" battery should be connected with the negative "A" battery terminal. The wire of the cable which would ordinarily be connected for the negative "B" lead can be used for the negative "C" lead instead. In that case, the negative terminal of the "B" battery and the positive terminal of the "A" battery should be connected together at the batteries rather than at the set.

Before connecting up your batteries, check over the wiring to be sure that no errors have been made. When you are sure everything is all right, connect your batteries and make a final check by testing across the filament terminals of the sockets to see whether you have the proper filament voltage across the terminals. Be sure that the battery switch and rheostats are turned "on" when you make the test.

After all these preliminary tests have been made you can insert your valves, connect up antenna, ground and reproducer and tune in.

The knurled edges of the two tuning controls project through the panel and are spaced only a small fraction of an inch apart. This spacing is sufficient so that the two drums may be turned separately, or by the simple expedient of pressing the knurled edges together between the thumb and first finger the two controls will turn as one. To tune in the first station the two controls should be tuned individually. It may be found that there is a difference of a few degrees between the two settings. This difference should continue approximately the same throughout the waveband, and after the difference has once been determined by tuning in one station then the controls can thereafter be turned together as a single control. This applies particularly in the case of reception from local stations. In tuning in distant stations a slight readjustment of the individual controls will probably have to be made to bring the circuits into exact resonance.

All volume control should be done with the right-hand rheostat which controls the filament voltage of the high-frequency valve. Never use the tuning controls to adjust for volume.

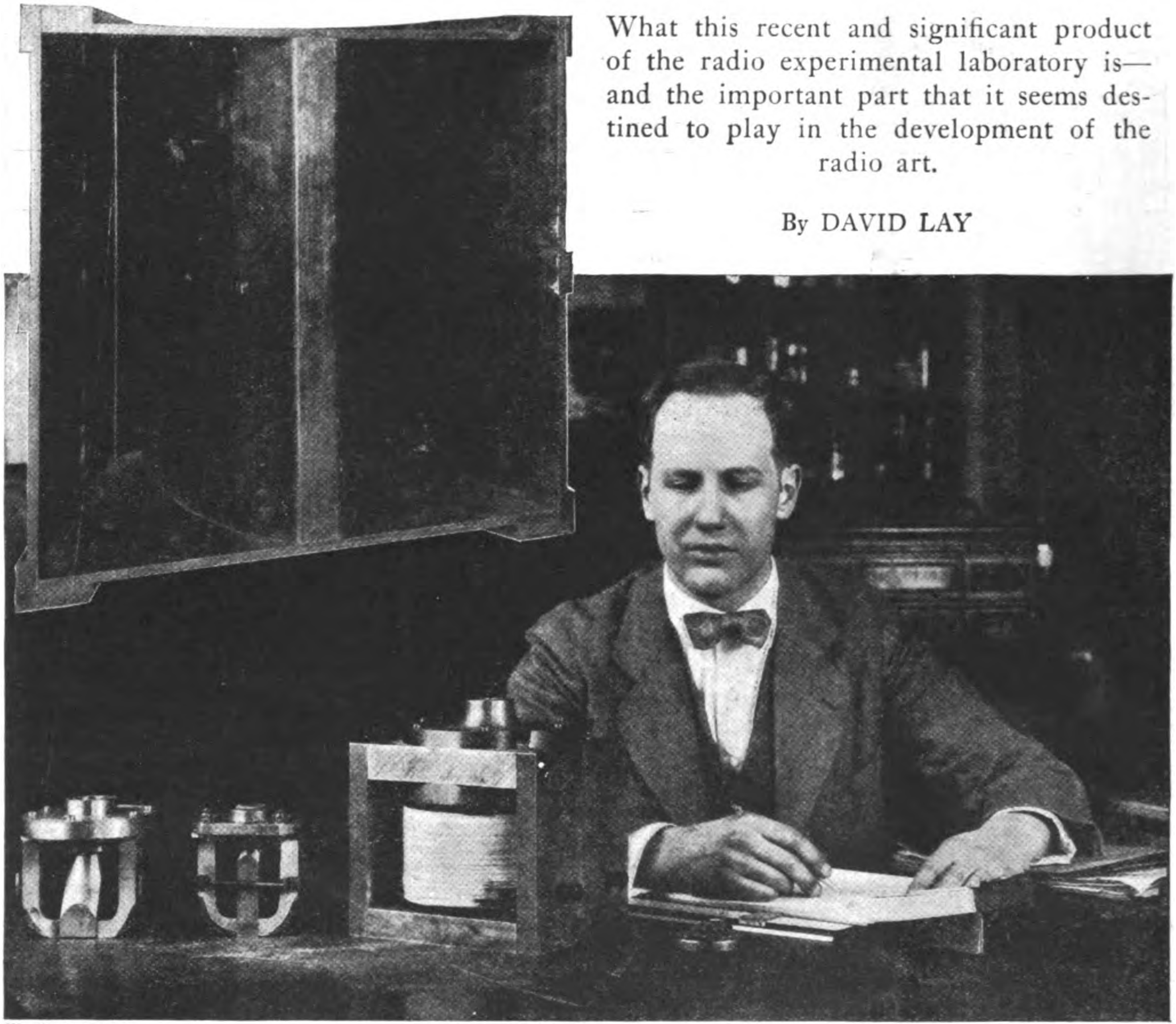
The detector rheostat should be adjusted for maximum signal strength and then turned back as far as possible without sacrificing either the volume or quality.

¶ *The list of parts given on page 18 includes the exact instruments used in the unit from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* Popular Radio *which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* Popular Radio Service Bureau, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

The New "Exponential Horn"

What this recent and significant product of the radio experimental laboratory is—and the important part that it seems destined to play in the development of the radio art.

By DAVID LAY



Westinghouse

ONE OF THE NEW EXPONENTIAL HORNS AND ONE OF THE MEN WHO PUT THE EXPONENTS INTO IT

Mr. C. R. Hanna is one of the two Westinghouse engineers who developed, back in 1924, the theory of the exponential horn; he and Dr. Slepian have since perfected the folded horn, shown above. The mouth of this horn is approximately four feet square. On the table in front of Mr. Hanna is one of the loudspeaker units used with these new Westinghouse horns.

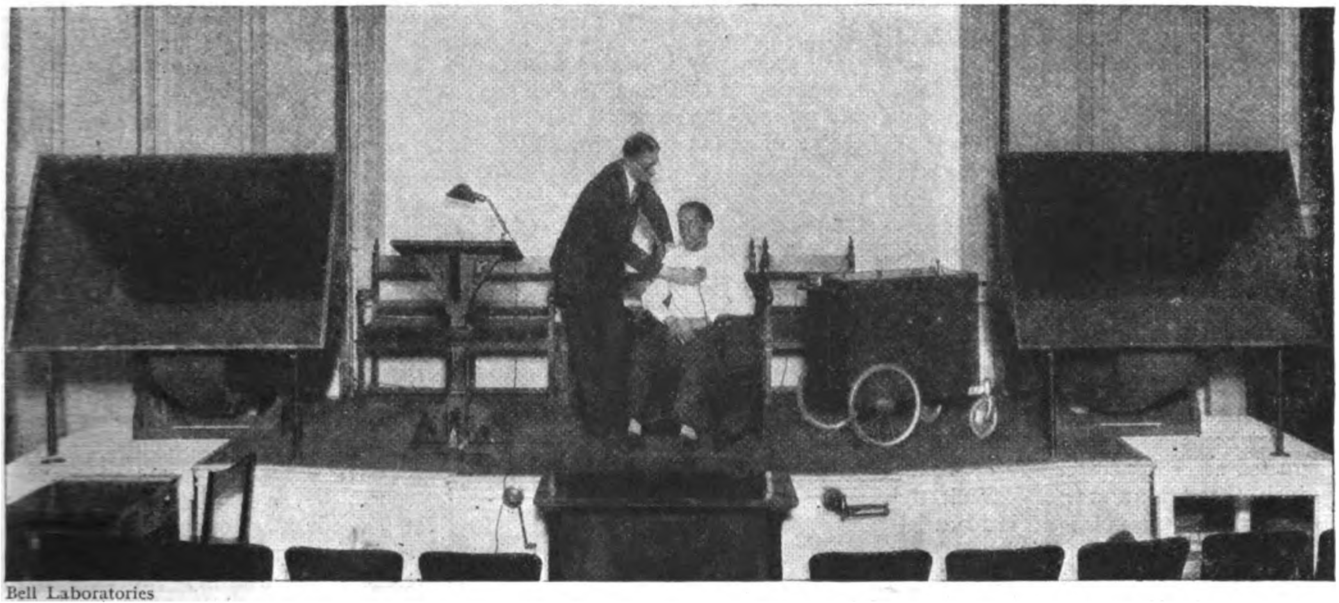
A NEW device is beginning to make a noise in radio. It is the so-called "exponential horn."

This horn is a new sound outlet for loudspeakers—and one which promises both to alter and to improve our present methods of discharging into the air the music and speech received by radio devices.

On the afternoon of May 12, 1927, a group of newspaper men and invited guests stood on one side of a valley near Pittsburgh, Pennsylvania. They listened to speech and music thrown across at them from the other side of the valley, where stood the research laboratory of the Westinghouse Electric & Manufacturing Company. Motorists who chanced to be following the road along the valley's bottom, an occasional gardener digging up what he hoped would prove to be his beds of summer vegetables, housewives in their near-by kitchens; all were astonished to hear what seemed like celestial music rolling down out of the air around them. Although some of the listeners were more than a mile away from the quite ordinary-looking horn set up at the Westinghouse laboratory, both speech and music were audible clearly and loudly.

The occasion was a demonstration of a new form of the exponential horn developed by two Westinghouse engineers, Mr. Clinton R. Hanna and Dr. Joseph Slepian. These are the same experts who presented before the American Institute of Electrical Engineers in 1924 the mathematical theory upon which the present practical developments are largely based.

Although probably the most spectacular of the recent applications of the exponential principle of horn design, the demonstration arranged by the Westinghouse engineers on the Pittsburgh hillside stands by no means alone. The exponential principle has been applied



Bell Laboratories

TWO EXPONENTIAL HORNS REPORT A BEATING HEART

These two horns, both of an exponential design, were used by Mr. H. F. Hopkins to demonstrate the electrical stethoscope before the Kings County Medical Society, in Brooklyn, New York. Both horns are folded, so that greater length can be obtained without occupying too much space, but the exponential principle of increasing cross-section is carefully maintained. With these horns even the lowest rumbles in the sounds of the human heart can be made audible to a large audience.

importantly in recent horn designs by the engineers of the Bell Telephone Laboratories, including the designs for the horn of the Orthophonic Victrola and for the great horns used with the Vitaphone. It has been applied to the horn developed by Mr. H. P. Donle and illustrated on page 15 of this issue. Numerous other horns, intended for radio loudspeakers, for public-address systems and for other purposes, have been designed or are in development.

It seems unquestionable that something new has come, at last, into the field of the loudspeaking telephone.

It would be foolish to try to predict the detailed development of this new exponential principle. Prophets are not lacking to say that "the day of the cone loudspeaker is over"; that the old, familiar horn, once all but universal, will sweep the field once more.

This may prove to be true. But there are other possibilities, one of them being that the new exponential horns will be found to have their chief utility where reproduction must be loud, leaving to the present-day cone loudspeakers the varieties of reproduction in which loudness is not so essential.

Only time will tell the truth of such forecasts. This one fact, however, seems to be sure: whatever horns are designed from now on for acoustic purposes are apt to be based, in whole or in part, upon the exponential principles now in such rapid development. It may be safely said, I believe, that the invention of these principles will retain for the horn type of reproducing device a necessary and honorable field in radio and in the phonograph arts, even though this field turns out not to include absolutely all of the industry.

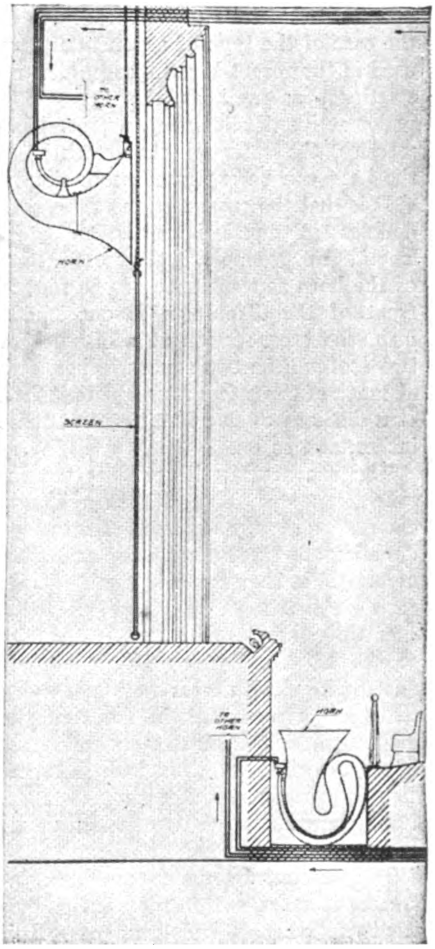
The word "exponential" does not refer to the width of the horn, to its length, to its acoustic properties, or even to such matters as the details of its shape. It refers merely to the mathematical theory, a part of the standard physical theory of sound waves, according to which the new horns are designed.

In mathematical notation an "exponent" is a figure which indicates powers of numbers or roots of numbers.

For example, if you wish to set down mathematically the square of x or the square of ten, you write the x or the 10 followed by a small superscript figure 2. This figure is the "exponent." If the cube is to be indicated instead of the square, the exponent is the figure 3; similarly the exponent 4 indicates the fourth power of the number, which is the same as the square of the square, and so on. Readers of POPULAR RADIO are already familiar with the method of indicating very large numbers by powers of ten. The figure 10, for example, with an exponent of 6 indicates the sixth power of ten, which is the same as the cube of the square of ten, or, in ordinary notation, the same as one million.

If roots are to be expressed instead of powers, the exponent is negative. For example, an exponent of — 2 indicates the square root; an exponent of — 3 indicates the cube root, and so on.

Modern mathematics make great use



AN INSTALLATION IN A THEATER

When the exponential horns of a public address system are installed in a theater, one or more horns are placed in the orchestra pit and another set is hung behind the curtain, at the top of the stage.

of this device of exponents, both in ordinary algebra and in the more advanced varieties of mathematical calculation. The science of mathematical physics has found it convenient also to make use of exponential symbols and of equations in which powers or roots of quantities, all indicated by exponents, are contained. These are called "exponential equations." So universally are they employed nowadays in the theories of electricity, of sound, of light, and of other branches of physics, that modern physics has been called an "exponential science."

This makes clear the reasons why the new horns are called exponential horns. These horns are designed and constructed according to theories of sound, which theories are most conveniently expressed in the form of exponential equations. Instead of making models or diagrams illustrating the shape of horn desired, the modern acoustic designer may write down a mathematical equation, expressed in exponential terms and indicating exactly how the horn is to be built.

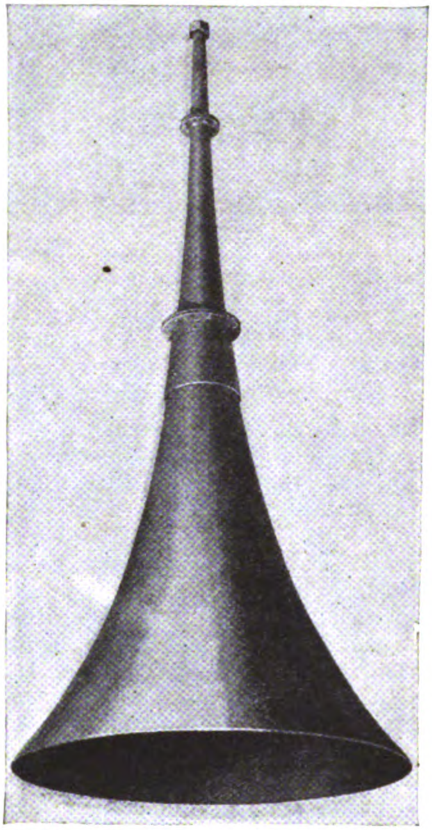
For the ordinary student of radio it is unnecessary to pursue these more complicated details of horn theory. In the case of the type of exponential horn used in the recent Westinghouse demonstrations, as well as the types now under active development in other laboratories, the essential characteristic of the horn can be expressed more simply.

It is that the cross-section of the horn doubles at equal intervals along its length. For example, if the cross-section of the horn at a distance of one foot in front of the diaphragm is one square inch, the cross-section at a distance of two feet will be two square inches, at a distance of three feet four square inches, at a distance of five feet sixteen square inches, and so on.

The exponential theory does not require, however, that the horn should enlarge as slowly as this. Instead of doubling the cross-section for each foot of length, it is possible to double it for each six inches of length or even for each three inches of length. In the case of the last-named horn, if the horn is one square inch in cross-section at a distance of three inches in front of the diaphragm, it will be two square inches in cross-section at a six inch distance, eight square inches at a foot distance, 128 square inches at two feet distance, and so on.

The amount by which the horn increases in cross-section for each unit of length is what is called its expansion ratio. This may be varied, making long, narrow horns or short, wide horns, all of them still retaining the essential exponential principle; the principle by which the cross-section of the horn increases by the factor 2 for each equal increment of length.

To prove why it is that a horn corresponding to this principle has properties of such great value for the discharge of sound would involve a long mathematical discussion of little interest except to specialists. By analogy with the proverbial pudding, the proof of the horn is in the hearing. It has been agreed by every one who hears the new exponential horns that this test is passed with flying sounds, if not with flying colors. There can be no doubt that horns which correspond to this exponential principle of design are much more satisfactory sound radiators than are horns which fail to meet this mathematical test.


Bell Laboratories

A STRAIGHT MODEL OF EXPONENTIAL HORN

This unfolded exponential horn (made in three sections) shows the regular expansion of the horn in diameter, as required by the exponential principle. This type of horn has proved successful in public address systems for out-of-door use.

Although the fact is well known to experts, it is not so well known, perhaps, to the radio beginner, that the horn of a loudspeaker adds nothing to the initial intensity of the sound. All of the sound which is to come out of any kind of horn must be present in the vibration of the diaphragm at the small end of the horn. However, if this diaphragm is allowed to vibrate freely in the air, without any kind of horn in front of it, it discharges relatively little sound. The reason is that the diaphragm does not adequately "couple" with the air; which means that the area of the diaphragm is so small that the amount of air set into vibration by it is minute. The sound wave which proceeds outward from this center of disturbance is a relatively feeble one.

The advantage of the cone loudspeaker over a simple vibrating diaphragm, like the diaphragm of a telephone, is that the cone possesses a much larger vibrating surface. Accordingly, it sets into vibration enormously greater masses of air. This produces and discharges a far more intense wave of sound.

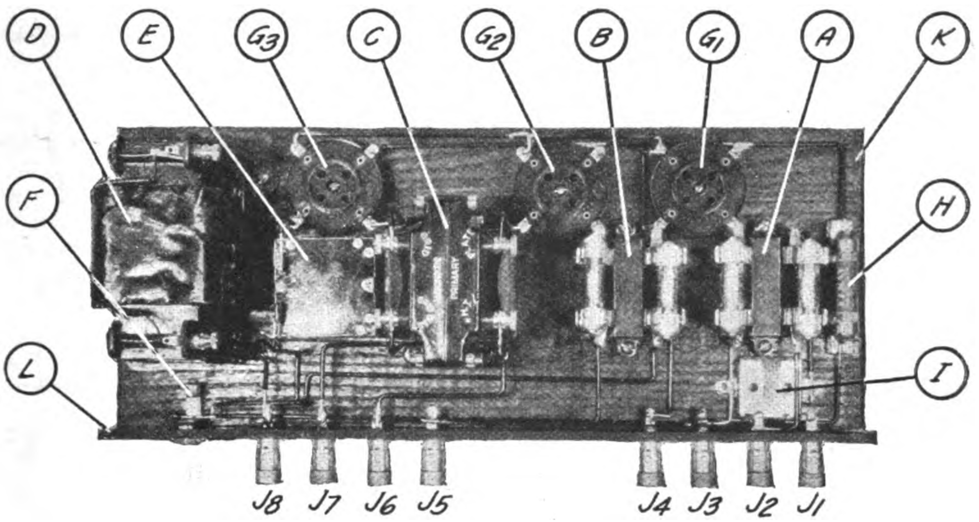
The advantage of any variety of horn, whether the new exponential one or the older more arbitrary varieties, comes from a similar ability to set more air into vibration in correspondence with the vibration of the diaphragm. This diaphragm, at the inner end of the cone of air contained inside the horn, sets this entire cone of air into vibrations like those of the diaphragm itself. In effect, the radiating surface from which sound waves are emitted becomes, not the relatively small surface of the diaphragm itself, but the entire front surface of the cone of air contained within the horn.

The advantage of the exponential horn, as may be shown mathematically from its detailed theory, is that it permits this preliminary communication of the sound to the internal cone of air and thence to the general air outside to take place with the minimum of interference and resistance. In technical terminology, the exponential horn "loads" the diaphragm more completely and with less distortion than can be accomplished with other existing kinds of horns.

In comparison with the cone loudspeaker the exponential horn probably will find its greatest advantage in an increase of loudness.

Ignoring electrical characteristics and confining attention to acoustic ones, there are three essential characteristics of a loudspeaker. One of them is the loudness; that is, the sound intensity which the loudspeaker emits for a certain electrical input (or a certain amplitude of vibration) of the diaphragm. The second is the amount of distortion which is produced, which means the degree (if any) to which the apparatus changes the acoustic characteristics of the sound vibrations emitted by the diaphragm. Third is what is called the "cut-off." This means the points of low frequency and of high frequency

(*Continued on page 76*)



A VIEW OF THE NEW AMPLIFIER AS SEEN FROM ABOVE

FIGURE 1: *This illustration shows the general arrangement of the various instruments that are used in this unit. They are all mounted on a baseboard and are designated by letters that correspond with the list of parts and with the text of the article.*

A New Amplifier for Your Old Set

NUMBER 4. *How to build a low-frequency amplifier that utilizes two resistance-coupling units and one high-grade transformer-coupled unit*

This series of constructional articles describes in detail the modern methods of amplification at low frequencies for obtaining quality reproduction. The amplifier units are small, compact and easy to build and they may be inserted either in an old receiver or in a new one to obtain undistorted amplification.

By THE TECHNICAL STAFF

COST OF PARTS: *Not more than $32.00*

HERE ARE THE PARTS THAT WERE USED IN THE LABORATORY MODEL OF THIS UNIT—

A and B—Amsco resistance-coupler units;
C—Ferranti low-frequency transformer, type AF3;
D—Amer Choke, No. 854;
E—Tobe paper condenser, 4 mfd.;
F—Any approved single-circuit jack (the Carter jack is illustrated in the diagrams that accompany this article);
G1, G2 and G3—Any approved cushion sockets (Amsco sockets illustrated);
H—Any approved automatic filament control for 1 ampere (Amperite control illustrated);
I—Any approved mica fixed condenser, .0005 mfd. (Aerovox fixed condenser illustrated);
J1, J2, J3, J4, J5, J6, J7 and J8—Any approved binding posts (X-L binding posts are illustrated in the accompanying diagrams);
K—Hardwood baseboard, 6 by 14 by ½-inch;
L—Bakelite binding-post strip, 1½ by 14 by 3/16-inch.

HERE is a new amplification unit that is of value both to the owner of an old type of radio receiver and to the owner of a recent type. But its special appeal is to the former—for the simple reason that it enables him to "modernize" his old set with the aid of new apparatus.

This new amplifier embodies a new combination of *both* resistance and transformer coupling—with remarkably good results.

The amplifier may be installed in place of the old-fashioned unit in an old receiver. It will give him an enormous volume with exceptionally true-to-life quality and will bring out the drum and bass notes in a particularly realistic and impressive manner.

The model described was designed especially for this use by the staff of POPULAR RADIO EXPERIMENTAL LABORATORY; the results obtained were excellent.

The schematic wiring diagram is shown in Figure 3.

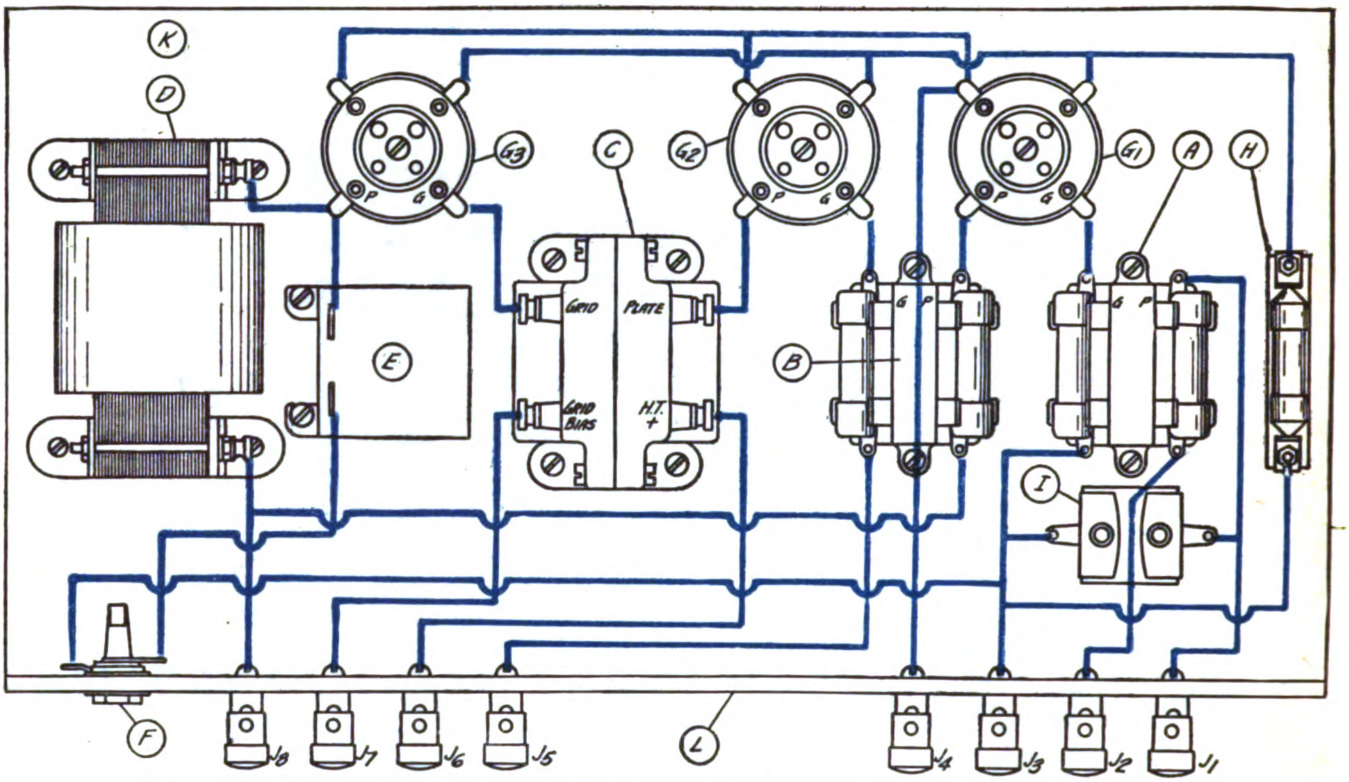
How to Construct the Unit

To build the amplifier, cut the baseboard, K, to the proper size, 6 by 14 and ½-inch. Then prepare the binding-post strip, L, as shown in Figure 2. The eight binding posts, J1, J2, J3, J4, J5, J6, J7 and J8, as well as the jack, F, should be attached to the strip.

The first two binding posts, J1 and J2, are for the input connections to the receiver with which the amplifier is to be used; binding posts J3 and J4 are for the "A" battery; J5 is for the second stage "C" battery negative; J6 is for the "B" battery plus (+) for the second valve; J7 is for the "C" battery negative for the third stage and J8 is for the high voltage "B" battery positive for the first and third valves.

Notice that the "B" battery negative should be connected to the "B" battery positive of the detector "B" battery used with the receiver. These battery connections are all shown in Figure 4.

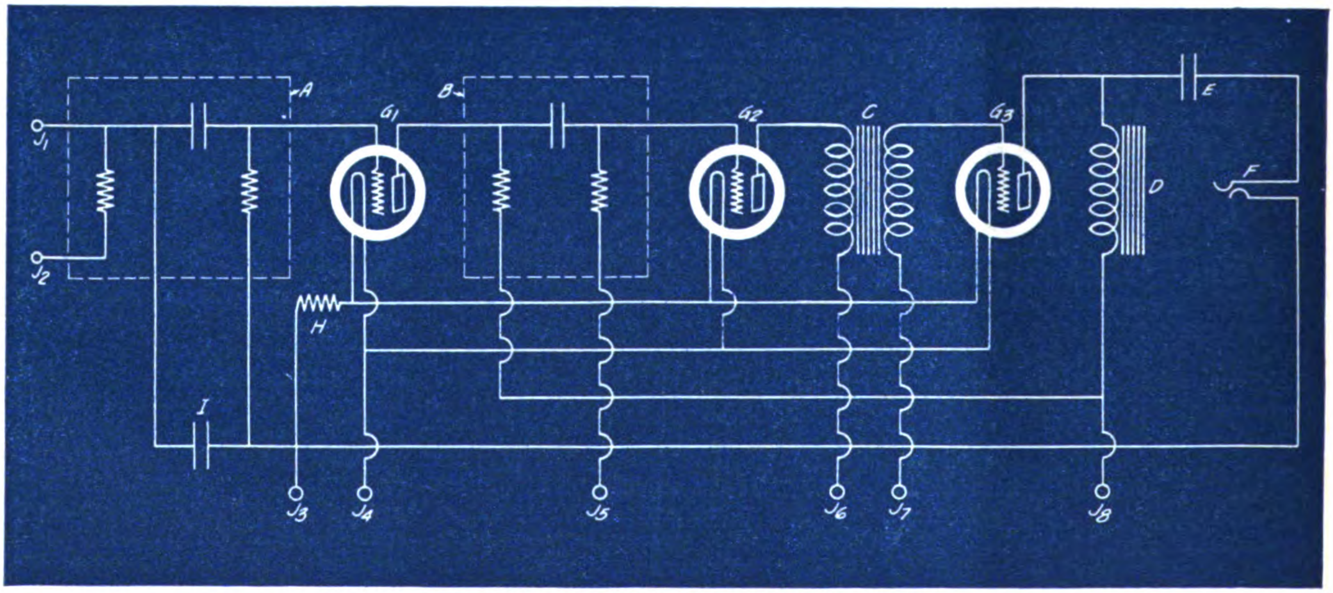
To proceed with the construction of the unit, the instruments may be fastened down in their relative positions by means of wood screws driven into the baseboard, K. The proper layout is given in Figure 2, which may also be



THE PICTURE WIRING DIAGRAM

FIGURE 2: *This drawing shows exactly how to hook up the various instruments in their respective electrical places in the circuit. The heavy blue lines indicate the wiring, while the black lines indicate the outline of the instruments themselves.*

¶ *The list of parts given on page 25 includes the exact instruments used in the laboratory model of this receiver. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instrument. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE THEORETICAL CIRCUIT EMPLOYED

FIGURE 3: *Here is shown the schematic diagram of the amplifier. The units indicated by dotted lines, A and B, are complete resistance-coupler units that couple the two tubes, G1 and G2. These are followed by a high quality transformer, C, and a power tube, G3. The output circuit contains a filter that improves quality, at the same time protecting the loud-speaker from heavy DC currents.*

used as a picture wiring diagram so that no mistakes are made in wiring.

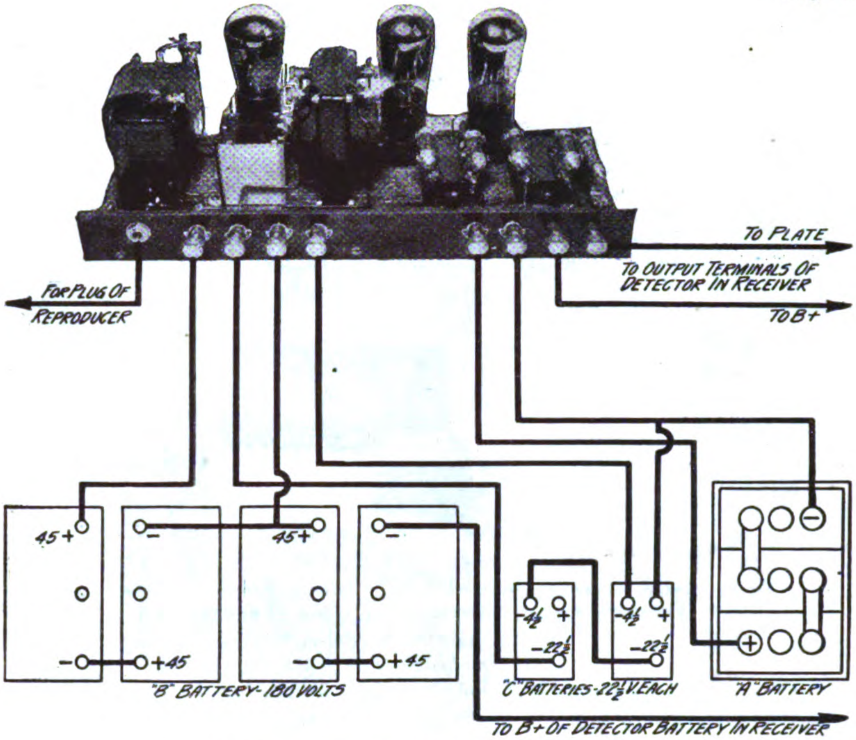
The wiring scheme in Figure 2 carries out the electrical hook-up shown in Figure 3. When the wiring is completed, the unit is ready to be installed and the batteries may be connected exactly as shown in Figure 4.

In the first two valve sockets, G1 and G2, insert two UX-201-a type valves and in the last valve socket insert a UX-171 type valve.

Notice that the last stage is equipped with an output unit that keeps the high voltage direct current from the windings of the loudspeaker while allowing the signal to pass through it.

When the valves have been placed in their respective sockets, and the amplifier input connections are made to the detector output connections of the receiver, the unit is ready for use. It should be used with a reproducer that is capable of giving high quality reproduction. The reproducer is plugged in by means of a phone plug into the jack, F.

The receiver that this unit is used with should be tuned in the usual manner and should give much better results than with the old amplifier that was first used with it.


TO PLATE
TO OUTPUT TERMINALS OF DETECTOR IN RECEIVER
TO B+
FOR PLUG OF REPRODUCER
45+
−
45+
−
−
+45
−
+45
"B" BATTERY-180 VOLTS
−4½
+
−22½
−4½
+
−22½
"C" BATTERIES-22½ V. EACH
"A" BATTERY
TO B+ OF DETECTOR BATTERY IN RECEIVER

HOW TO HOOK UP THE AMPLIFIER

FIGURE 4: *The proper connections to the amplifier from the batteries are given in this composite diagram. The connections to the detector tube and the reproducer are also indicated by the arrow-tipped lines in the upper right-hand and left-hand corners.*

Harris & Ewing

A MINIATURE RADIO SET TO CLAMP ON YOUR TELEPHONE STAND

The ordinary telephone receiver may be used for picking up broadcast programs by means of this little attachment that has been invented by Mr. George F. Mitchell, of Washington, D. C. The visible receiving equipment is a wooden slab that encloses the crystal or tube detector and the wires for making connections to the telephone and to the "ground"; the telephone wires serve as the antenna. This miniature set interlocks with the regular telephone stand; two pins are used for making electrical connections between the radio unit and the cords that extend to the telephone receiver. The device does not interfere with the telephone service.

The NEW 1928 MODELS

The advance information was obtained directly from these new receivers; it was diced tests conducted in the

By the TECHNICAL STAFF

The New Marti Receiver

Features: *Uses six AC valves; includes a device that eliminates necessity for an antenna except for distant stations; retails for under $250, with entire power-pack equipment as well as the valves.*

This is the time of the year—in July and August—when the far-sighted radio fan begins to look over the new 1928 models of receiving sets. For this is the time of year that the coming season's models are making their appearance.

A review of the advance models of the latest receivers that have been tested by the Popular Radio Laboratory reveal two outstanding facts:

First, that while the fan will not have submitted for his selection the wide assortment of factory-built sets that in the hurly-burly days of broadcasting literally glutted the bewildered market, all of the models are designed on sounder scientific principles and are better constructed than before, and consequently represent sounder values;

Second, that a sufficient variety of models are available to meet the needs of both the fat and the thin purse, and of the city as well as the country dweller.

The advance information on a representative group of the new models, incorporated in this article, was obtained direct from the engineers and factories by the Technical Staff of Popular Radio, and the brief summaries of the outstanding characteristics of each receiver here listed represent the unbiased opinions of the Popular Radio Laboratory.

For convenience to the reader, each receiver is here described specially in detail.

* *

The New Marti Electric Power Radio

Description: This is a six-valve receiver which includes two stages of tuned high-frequency amplification, a vacuum valve detector and three stages of resistance-coupled, low-frequency amplification. The vacuum tubes are supplied with the receiver and are of the McCullough AC type with their cathodes heated by means of alternating current. The transformer used to step down the AC voltage to that required for heating the cathodes is built into the receiver, as is the "B" power-pack which converts the alternating lighting current into high voltage, direct current for the plate supply. A UX-216-b type valve is used as the rectifier. The receiver is tuned by means of two illuminated controls on the front of the cabinet. One of these tunes the input circuit, while the second control tunes the second and third tuned circuits together.

This receiver is available in either the table-mounting model shown in the illustration, with the power-pack equipment built in, or in a desk console model. The latter also contains a built-in reproducer of the orthophonic type. Both models are done in two-tone walnut. The receiver operates with an outdoor antenna of from 50 to 100 feet in length, depending on the proximity to the local broadcasting stations. Good local reception is made possible without an antenna, by means of a device that is built into the receiver and which causes the AC supply lines to function as an antenna as well as a current carrier.

Outstanding features: It is of compact size for a receiver which includes the entire power-pack equipment; no batteries are used, and no antenna is required except for distant reception.

Maker: Marti Electric Radio Co.

* *

The New Fada Special

Description: This is a 6-valve neutrodyne receiver of the table mounting type and is designed to be used either with batteries or power-packs that draw their supply from the house-lighting lines. Either an indoor or outdoor antenna may be used.

The receiver makes use of UX-201-a type valves in all but the last low-frequency amplifier stage, where a power valve of the 171 type is recommended. There are three stages of high-frequency amplification, two of which are tuned and one untuned. The two tuned stages are controlled by a single knob on the front of the receiver; a second control knob tunes the "input" or antenna circuit. The third control on the receiver front serves a dual purpose as the volume control and "off" and "on" switch. The coils and wiring of the high-frequency circuits are shielded to prevent stray pick-up and to reduce interstage coupling.

The high-frequency amplifier is especially designed to provide uniform sensitivity throughout the entire waveband from 200 to 600 meters. The tuned stages provide maximum sensitivity over only a part of this waveband, but at the point where their sensitivity starts to drop the sensitivity of the untuned stage increases, thus maintaining an even and high degree of amplification on all wavelengths.

The low-frequency amplifier consists

IN RADIO RECEIVERS

incorporated in this article
the engineers who developed
supplemented by unpreju-
POPULAR RADIO LABORATORY

of POPULAR RADIO

of two transformer-coupled stages. The tonal quality of this amplifier is such as to warrant the use only of a high-grade reproducer such as the Fada cone-type speaker.

The receiver is housed in an attractive mahogany cabinet that is finished in velvet brown duo-tone mahogany.

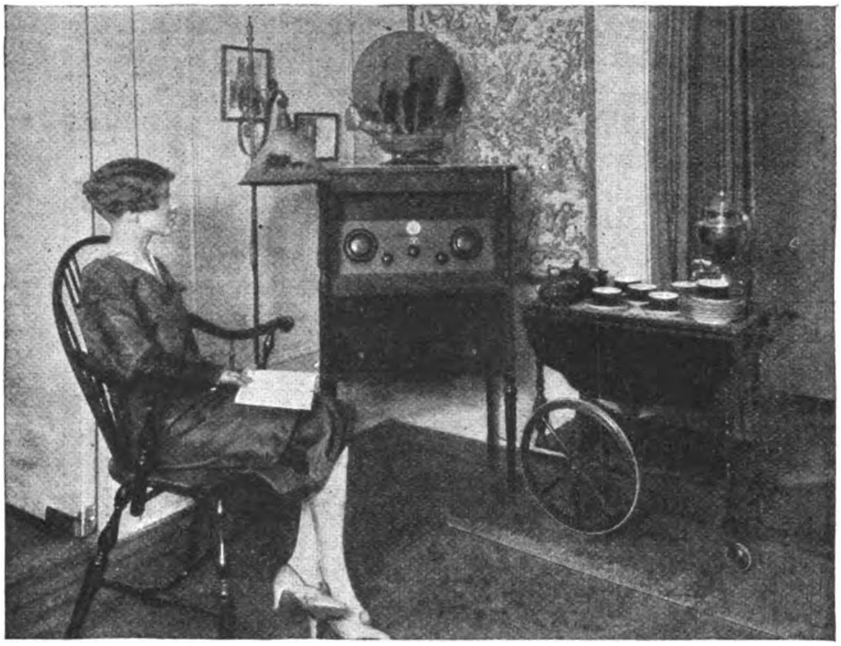
Outstanding features: All the coils are shielded. Uniform sensitivity is attainable throughout the waveband. The plate current consumption is low.

Maker: F. A. D. Andrea, Inc.

The New Fada Receiver

FEATURES: *Is liberally shielded and includes other details found usually only in the higher priced sets; low plate current consumption and uniform sensitivity are attainable throughout the waveband; retails for less than $100, without equipment.*

* *



The New Nassau Receiver

FEATURES: *Operates entirely on the house-current electric lines; uses six standard valves, with 210 power valve in the last stage; retails for about $300, including a built-in power supply unit (but not including the valves).*

The New Nassau Power Radio—Type D L P

Description: This is a console type receiver which obtains all its operating power from the AC lighting lines. In the lower part of the console cabinet is a totally shielded "ABC" power-pack that converts the 110 volt, 60 cycle current to direct current, which is applied to the receiver at the various voltages required for filament, plate and grid circuits. The rectifier unit makes use of a UX-216-b type rectifier valve. The receiver uses five of the UX-199 type valves and one of the UX-210 type. This latter valve, used in the last stage of low-frequency amplification, provides an abundance of volume without overloading or distortion. The circuit consists of two stages of tuned-high-frequency amplification, a vacuum valve detector and three stages of "Truphonic"-coupled, low-frequency amplification. Two of the tuning condensers are mechanically coupled together and are tuned simultaneously by means of one tuning control. The condenser in the first stage is separately tuned. The three smaller knobs shown on the front panel in the accompanying illustration are for controlling volume, sensitivity and filament current. The meter shown on the panel is used to adjust the filament current to the proper operating point, regardless of the AC line voltage, providing the latter is somewhere between 95 volts and 125 volts. Just above the control panel is a dash light with an adjustable shade which lights up the controls and permits of easy tuning even in a darkened room. This light also serves as a pilot light, as it only lights when the receiver is turned "on." The console which houses this receiver is of satin-finished walnut. The receiver is equipped with an extension cord and plug for connecting to the house lighting lines.

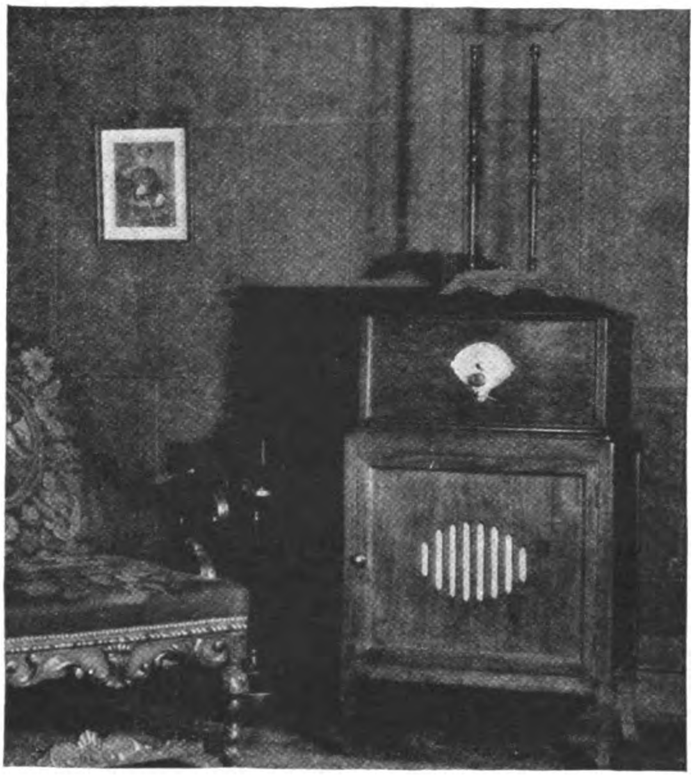
Outstanding features: No batteries are required; the power-pack is safe and fool-proof, as the case cannot be opened without first disconnecting it from the AC. It has great volume and gives reproduction of exceptional quality.

Maker: Nassau Radio Co.

* *

The New Ferguson Model "Fourteen"

Description: This is a ten-valve receiver which employs six stages of high-frequency amplification, a vacuum valve detector and three stages of low-frequency amplification. The high-frequency amplifier consists of three untuned stages and three tuned stages. The low-frequency amplifier consists of one



The New Ferguson Receiver

Features: *Has ten valves, with six stages of high-frequency amplification and only one tuning control. Retails for $235, including the loop antenna.*

transformer-coupled stage, followed by two stages of "Truphonic" coupling. Tuning is accomplished by means of a single control which is calibrated directly in wavelength. The receiver is designed primarily for use with a loop antenna, but it can also be used with an outdoor or indoor antenna. The "A" power supply is obtained from a storage battery and the "B" supply may be obtained from standard dry-cell "B" batteries or, preferably, from the Ferguson Hi-Power "B" power-pack. This power-pack delivers sufficient voltage to permit the use of a UX-171 type power valve in the last low-frequency amplifier stage. It also provides four different voltages, as required in the operation of this receiver.

The receiver is furnished in a walnut cabinet of the table-mounting type. A table to match, with a built-in reproducer and compartments for all equipment, as shown in the illustration, may also be obtained from the manufacturer, as extra equipment.

Outstanding features: It has *six* stages of high-frequency amplification, is entirely self-contained when used with table to match, and it eliminates the need for an antenna. It is extremely sensitive, has excellent selectivity and fine tone quality.

Maker: J. B. Ferguson, Inc.

The New Standardyne, Model S-27

Description: This is a 6-valve receiver that is tuned by means of a single control. Two other controls are also provided on the front of the receiver, to permit variation of volume and sensitivity to meet the requirements of the operator. The receiver consists of three stages of high-frequency amplification, two of which are tuned, a detector and two stages of transformer-coupled, low-frequency amplification. The single control tuning feature is obtained through mechanical coupling between the tuned circuits.

A power valve of either the UX-112 or the UX-171 types is recommended for use in the last low-frequency stage, and UX-201-a type valves in the other five sockets. The receiver is not furnished with power supply equipment, but is intended for use with either batteries or external power-packs, depending on the requirements and wishes of the user. An antenna of approximately 75 feet in length is recommended.

The table mounting model of this receiver is inclosed in a willow cabinet. The receiver may also be obtained in a console cabinet of mahogany veneer.

Outstanding features: The cost of the receiver is low. Tuning is done with a single control. The size of the antenna has no effect on the tuning.

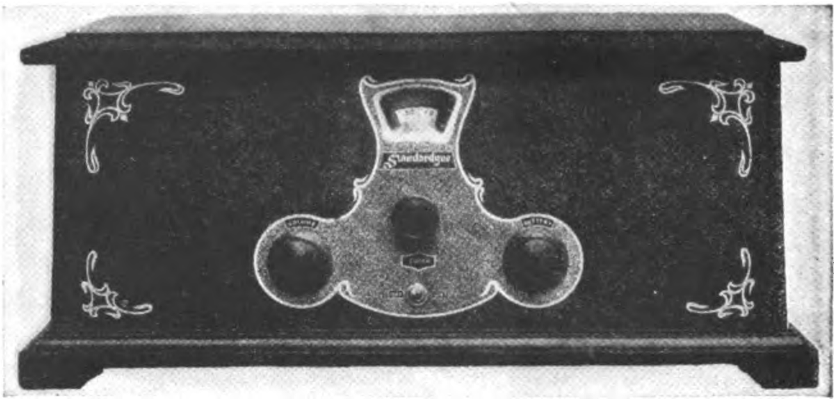
Maker: Standard Radio Co.

* *

The New Stewart-Warner Model 710 Matched Unit Receiver

Description: This receiver is inclosed in a console of attractive design, as shown in the illustration; it is of walnut and is finished with rubbed lacquer. The two large front doors swing open to disclose the receiver control panel and beneath this the grill behind which the built-in reproducer is located. In the lower compartment, space is also provided for all batteries or for power-packs, if they are used in place of batteries.

The receiver is a six-valve model which includes three individually shielded stages of tuned high-frequency amplification, a vacuum valve detector and two stages of transformer-coupled, low-frequency amplification. The valves recommended by the manufacturer are the Stewart-Warner 501-ax type throughout.



The New Standardyne Receiver

Features: *Includes several features usually found only in the expensive sets—not the least of which is a single-control tuning feature and three stages of high-frequency amplification. Retails for about $50.*

A power valve, however, may be used in the last low-frequency stage with improved results. Tuning is accomplished by means of a main control knob which tunes all but the "input" circuit. This circuit is individually tuned by means of an auxiliary control knob. The only other control is that for "volume." With the batteries or power-packs in place and connected up the receiver is entirely self-contained except for the antenna and ground connections. The antenna recommended is an outdoor wire about 75 feet long, if there are nearby broadcasting stations which might tend to cause interference, or 90 to 100 feet in length if the location is not too near local stations.

Outstanding features: The receiver is self-contained; it may be used either with batteries or with power-packs. It has an individually-tuned "input" or antenna circuit which permits the receiver to be exactly adapted to the antenna used. It is easy to operate.

Maker: Stewart-Warner Speedometer Corporation.

The New Stewart-Warner Receiver

FEATURES: *A six-valve receiver with a built-in reproducer, all housed in a cabinet modeled after the style of the new types of talking machines; may be used either with batteries or power-packs.*

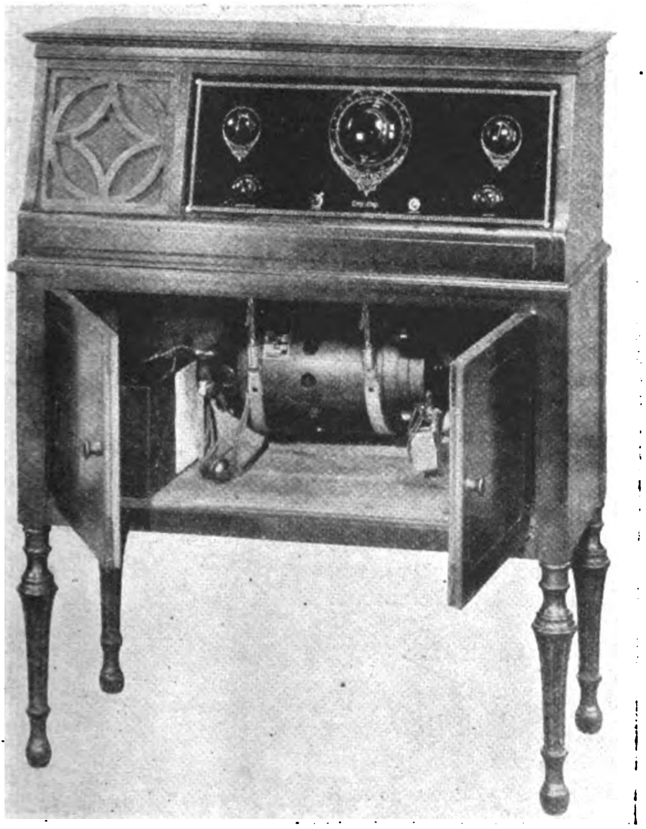
* *

The New Day-Fan MG-Six

Description: This is a six-valve receiver that employs three stages of high-frequency amplification, one of which is untuned, a vacuum valve detector and two stages of low-frequency amplification. It employs standard valves of the UX-201-a type, except in the last stage, where a power valve of either the UX-112 or the UX-171 type is used. The tuning arrangement is such that all circuits may be tuned simultaneously by the large central tuning knob, or the three tuned circuits may be individually tuned by independent adjustment of the knobs on either side of the main tuning control knob. There are also auxiliary adjustment knobs for controlling selectivity and volume to fit the requirements of the user.

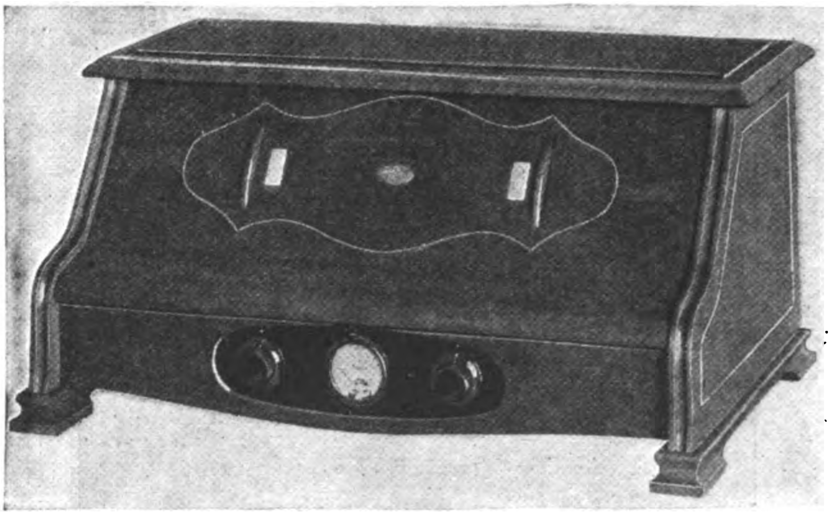
The receiver and cone-type reproducer are inclosed in a single cabinet of hand-rubbed walnut. A screened grill conceals the reproducer. The base of the receiver consists of a radio table with an ample equipment compartment. This is finished to match the receiver cabinet.

One unusual feature of this set is the fact that all operating voltages are supplied by a motor-generator which is cradled in a spring suspension in the



The New Day-Fan Receiver

FEATURES: *This is perhaps the first radio receiver to use a small generator to supply all required operating voltages; otherwise it employs standard equipment; is self-contained except for antenna and ground connections. Retails for $300, less valves.*



The New Wright-DeCoster Receiver

Features: *A seven-valve set that operates on dry cells; dry-cell "A" and "B" batteries may be used exclusively, or any combination of dry cells, storage battery or power-pack may be employed. Retails for about $150.*

equipment compartment itself. This unit operates from the 110 volt, 60 cycle house-lighting lines and generates direct current of suitable voltage. This direct current is filtered and is adapted to the various requirements of the receiver by means of resistances so as to supply the "A," "B" and "C" voltages.

Outstanding features: No batteries are required; it is self-contained except for antenna and ground connections. It is of neat design, has good tone quality and excellent selectivity.

Maker: Day-Fan Electric Co.

* *

The New Wright-DeCoster, Model VII

Description: There is still a tremendous demand for receivers which can be operated entirely from dry cell batteries; over half of our farms are without electricity, and many of these have no local facilities for charging storage batteries. There are also countless homes in cities and suburbs that are still without electrical supply. A good receiver that can draw all its operating power from dry cells is, therefore, in demand.

The Wright-DeCoster receiver fills this demand. It operates with maximum efficiency when a set of six standard 1½-volt dry cells are used for lighting the valve filaments and a set of three standard 45-volt "B" blocks for the plate supply. Equally good results are obtained with a four-volt storage battery for the filament supply.

The receiver uses six of the UX-199 type valves and one UX-120 type. There are three stages of tuned, high-frequency amplification, a vacuum valve detector and three stages of "truphonic" low-frequency amplification. The receiver is intended for use with an outdoor antenna of 80 feet or more in length. Tuning is accomplished with two drum-type controls, one of which tunes the three high-frequency stages together and the other the antenna input circuit individually. There are two power controls. One of these varies the volume and sensitivity to suit the taste of the listener and the other varies the filament voltage. The proper setting of this latter control is indicated by the voltmeter which is mounted on the front of the receiver.

The cabinet is of the table mounting type and is finished in satin-duco, walnut. A table with a compartment for all batteries is obtainable as extra equipment from this manufacturer and also an excellent reproducer of the pedestal type.

Outstanding Features: This receiver is especially designed for use in homes where electric light lines are not available for charging a storage battery or for operating "A" or "B" power packs. It is equipped with voltmeter to insure proper adjustment of filament voltage, with a resulting long life of the vacuum valves.

Maker: Wright-DeCoster, Inc.

* *

The New Steinite, Model AC-1

Description: The AC-1 receiver is a high-boy console model which draws all its operating current from the AC house-lighting lines. The receiver proper makes use of four 199 type valves in the two stages of high-frequency amplification, detector and first low-frequency amplifier stages. A 301-a or a 112 type valve is used in the second low-frequency stage. The filament supply current and the high-voltage plate supply are obtained through a power supply unit which is incorporated in the cabinet. The necessary grid biasing voltages are also obtained from this source.

There are two tuning controls, one to tune the "input" and the other to tune the two high-frequency circuits. In addition to these two controls, the front panel also carries two operating controls, one to vary the volume of reproduction and the other to adapt the receiver to the AC line voltage existing in any particular location. This latter adjustment permits the use of any line voltage between 100 and 125 volts. There is no guesswork in this adjustment, as it is only necessary to turn this control knob until the meter on the control panel reads 3 volts, which is the proper filament operating voltage.

The reproducer is also built into the high-boy console, making the receiver completely self-contained, except for the antenna. The console is of Philippine mahogany in an antique shaded finish and is equipped with front doors which completely conceal and protect the instrument when not in use. The set is equipped with an extension cord and plug for connection to the house-lighting lines.

Outstanding features: The receiver is low-priced. No batteries are required. All operating voltage is obtained from the 100-120 volt, 60 cycle, house supply lines. It contains a built-in reproducer.

Maker: Steinite Laboratories.

* *

The New Steinite Receiver

Features: *Includes the power supply unit and the reproducer in the same cabinet as the receiver itself; operates completely on AC house current. Retails for about $150, which includes everything except the valves and the antenna wire.*

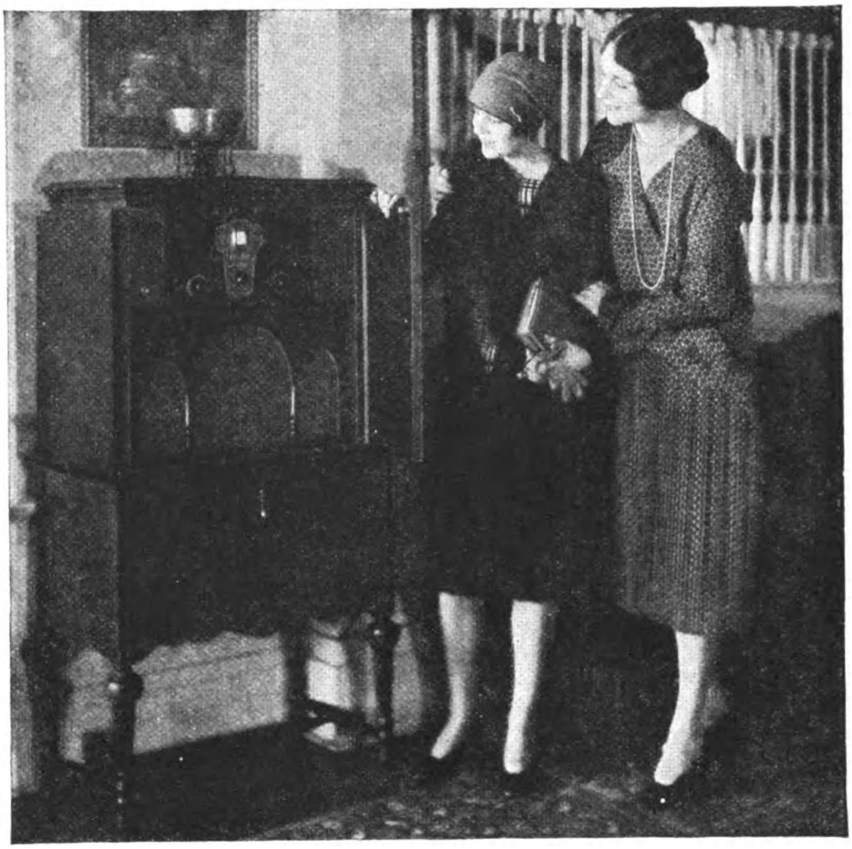
The New Kolster, Model 6-H

Description: This six-valve receiver is inclosed in a walnut veneer console, together with a power speaker and a "B" power-pack. The source of filament power supply is optional with the purchaser. A storage "A" battery may be used, or an "A" power-pack may be purchased from this same manufacturer, as extra equipment. There is room in the console to accommodate whatever supply unit is selected, thus making the receiver self-contained except for the antenna and ground wires.

The receiver employs six 201-a valves in three stages of tuned high-frequency amplification, a detector and two stages of transformer-coupled, low-frequency amplification. All tuning is accomplished by means of a single control on the front of the receiver. The antenna should preferably be of the outdoor type and should not exceed 50 feet in length if the receiver is used in the immediate vicinity of broadcasting stations. If used in a more isolated location, the antenna may be around 75 feet in length.

Outstanding features: The receiver includes a built-in power reproducer. It is designed to use either a storage "A" battery or an "A" power-pack. A "B" power-pack is included in the receiver.

Maker: Federal-Brandes, Inc.



The New Kolster Receiver

FEATURES: *Contains a built-in "B" power-pack and power amplifier; also a built-in reproducer. An "A" power-pack may be obtained as extra equipment to make the receiver entirely AC operated. Single-control tuning is employed and the tuning scale is calibrated in wave-lengths. Retails for about $250, not including valves or "A" power supply.*

* * *

The New Herbert "Lectro" Model 120

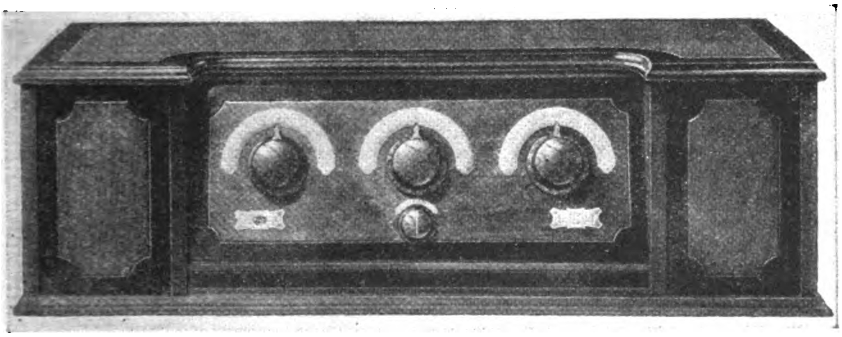
Description: This receiver is made in a table-mounting model and is housed in an attractive walnut cabinet that is finished in a two-tone effect. Tuning is accomplished by means of three pointer-knobs which move over calibrated scales on the front of the receiver. The only other adjustment is a smaller knob which controls the intensity of the signals, and thus serves both as a volume and a sensitivity control.

The receiver is electrically operated from the 110 volt, 60 cycle AC house lines, through the medium of a built-in "ABC" power-pack device which furnishes all voltages required by the receiver. The power-pack portion of the receiver is adjusted before it leaves the factory to provide the correct voltages for best operation of the receiver. No adjustments need be made by the user other than that of the "intensity" control knob mentioned above. This latter adjustment is not critical.

The receiver uses a QRS 85 milliampere rectifier valve in the power-pack, and four valves of the UX-199 type and one of the UX-112 type in the receiving circuit. The circuit consists of two stages of tuned high-frequency amplification, detector, and two stages of transformer-coupled, low-frequency amplification. It is intended for use with an outdoor antenna from 75 to 150 feet in length, including the lead-in. In congested locations, where there are nearby high-power broadcasting stations, the shorter length is to be preferred. An indoor antenna may also be used with good results.

Outstanding features: It uses no batteries, and no ground connection is required. It has a low first cost, a low operating cost. and is easy to install. The entire "ABC" power equipment is included with the receiver in a table mounting cabinet of normal proportions.

Maker: Harold Herbert, Inc.



The New Herbert "Lectro"

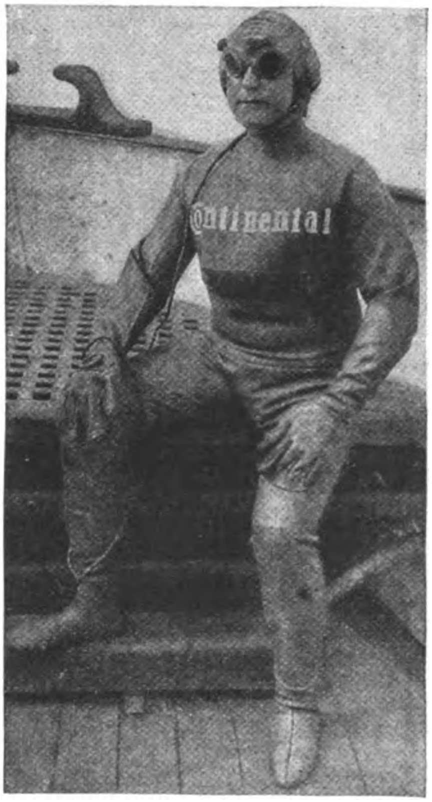
FEATURES: *A built-in power-pack is included in this receiver and supplies all operating current from the AC house lines. It may be mounted on any convenient table and requires no additional space for equipment. It retails for $120, not including the valves or reproducer.*

What's New *in* Radio

Conducted by

THE TECHNICAL STAFF

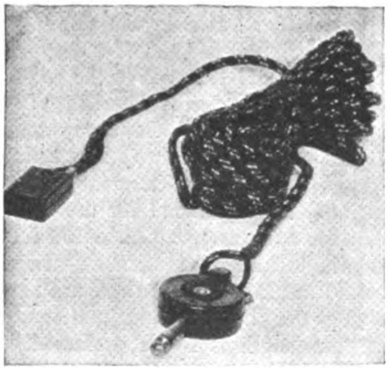
Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of Popular Radio informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the Popular Radio Laboratory it will be duly recorded in this Department for the information and benefit of all.



Henry Miller

A Unique Receiver for a Swimmer

A "stunt" in radio transmission and reception was recently demonstrated in Germany when a deep-sea diver, carrying a miniature transmitter beneath the water, broadcast radio signals to an airplane, which in turn rebroadcast them to Otto Kemmerick (shown above), who was swimming about in this unusual rubber suit that was equipped with a small receiving set and headphones.



A Cord That Permits Moving the Reproducer About

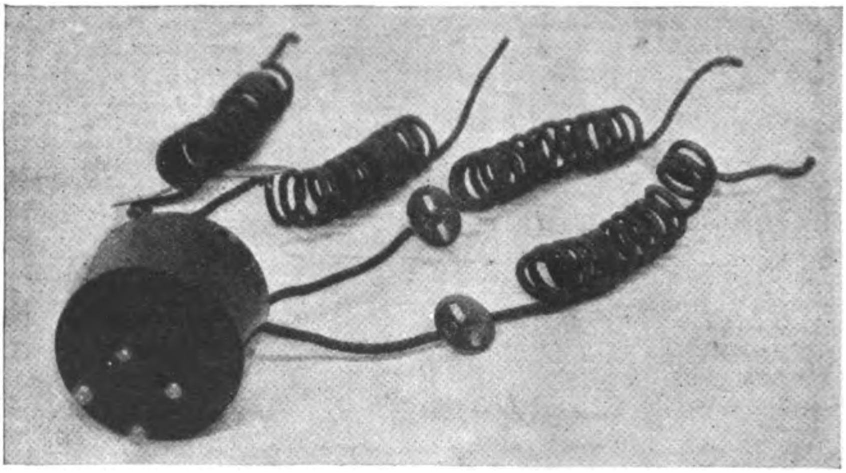
Name of instrument: Extension cord for a reproducer.

Description: This is a combination device which consists of a 50-foot reproducer cord, a plug and a connector block. The cord is made up of two flexible wires contained in a single cotton covering, and with the four ends terminating in phone tips. The tips at one end of the double cord are inserted in the plug and the plug is pushed into the output jack of the receiver. The tips at the other end of the cord are inserted in the pair of holes in one end of the small connector block and the phone tips on the end of the cord that is attached to the reproducer are inserted in the holes at the other end of this block. The reproducer can then be placed any distance from the receiver, up to 50 feet. These cords are also obtainable in 20, 30 and 40-foot lengths.

Usage: To be connected between reproducer and receiver to permit the former to be placed in another room or at some point distant from the receiver.

Outstanding features: It permits the reproducer to be placed in any part of the house, or outdoors if desired, without the necessity of moving the receiver. It is neatly made.

Maker: Frank W. Morse Co.



You Can Now Add a Power Valve to Your Receiver Without Any Change in Wiring

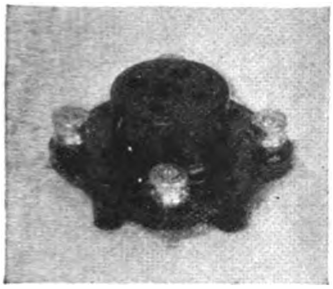
Name of instrument: Adapter for power valves.

Description: This adapter consists of a bakelite shell with four brass prongs on the bottom, similar to the base of a vacuum valve. Inside of the shell is a bakelite disc with four holes and spring contacts to accommodate the prongs of a standard UX-type valve base. There are also four flexible wire leads coming from the interior of the adapter. A power valve, such as the UX-171 type or the UX-112 type, may be plugged into the adapter, and the adapter then plugged into the socket of the last low-frequency amplifier stage of the receiver. The four wires coming from the adapter are then connected to the positive and negative terminals of the additional "B" and "C" batteries required for the operation of the power valve. These four wires are clearly marked, so there can be no mistake in connecting them up.

Usage: To provide a simple means for using a power valve in the last low-frequency stage of a receiver which was not originally designed to accommodate this type of valve.

Outstanding features: It provides for power operation without necessitating new wiring.

Maker: Carter Radio Co.



A Socket That Helps to Stop Microphonic Noises

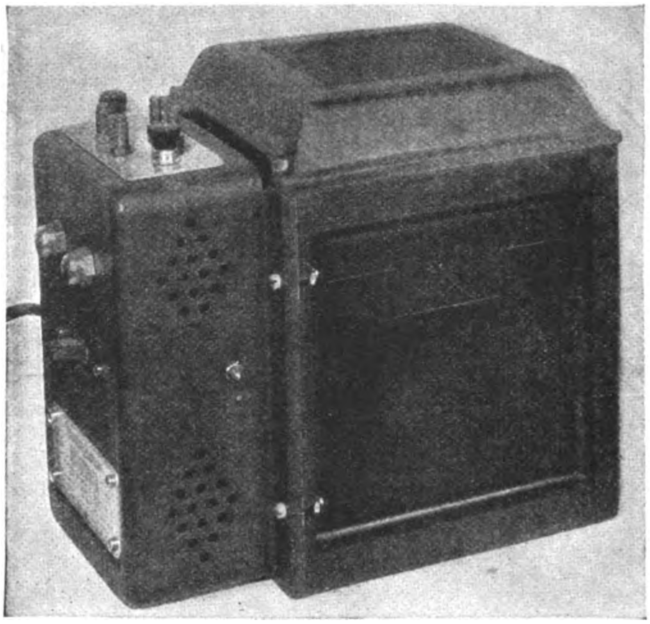
Name of instrument: "Shock-proof" valve socket.

Description: This socket consists of a flat composition base set up on four legs of the same material. The button part of the socket, into which the valve is plugged, is suspended from this base by means of four metal springs, so that when the valve is placed in the socket it will be supported flexibly by these springs. Each one of the springs is stamped and bent in such a way that it serves also as the spring contact against the valve prong and as the soldering lug to which the wiring connections are made. This one-piece construction precludes the possibility of poor connections within the socket. In addition to soldering lugs, the socket is equipped with binding-post terminals, for use where it is desired to make unsoldered connections.

Usage: As the mounting for vacuum valves in a receiver. It is particularly useful for mounting the valves which are likely to cause microphonic trouble, such as the detector valve and the valve in the last high-frequency stage.

Outstanding features: It makes positive contact with good spring action. Stops are provided to prevent the floating portion of socket from being pulled up too far or pushed down too far when inserting or removing valves.

Maker: Pilot Electric Mfg. Co.



An "A" Battery With a Unique Trickle Charger

Name of instrument: "A" Autopower.

Description: This unit consists of a small storage battery and trickle charger combined in one unit. The battery is enclosed in a rubber case with a cover and the trickle charger is enclosed in metal and is attached to one end of the battery. On the trickle charger is a switch by means of which the receiver is turned "on" and "off." When the switch is thrown to the "on" side, the charger is disconnected from the line and the battery is connected to the receiver. When thrown to the "off" side, the action is reversed. The trickle charger used is unique, in that it contains no liquids, nor does it use a rectifier valve of any kind. Rectification is obtained through the use of an entirely new type of "solid" rectifier which requires absolutely no attention. The unit is equipped with an extension cord and plug for connection to the house-lighting lines. There are several models of this unit for supplying either 4 or 6 volts and for use where the lighting line voltage is 110 volts at frequencies of 25 or 60 cycles.

Usage: To supply the power for lighting the filaments of standard 3 or 5-volt vacuum valves.

Outstanding features: It is positive in operation. An ample source of current is always available. It requires no attention, except occasional addition of water to the storage battery. It will operate any receiver regardless of the number of valves used. The charging rate may be varied from 1/10 ampere to ½ ampere by a simple adjustment provided on the outside of the rectifier unit.

Maker: Westinghouse Union Battery Company.

An Accurate Meter for "B" Voltages

Name of instrument: Model No. 515 high-resistance voltmeter, Style No. 3.

Description: This voltmeter is of the portable type and is enclosed in a wooden case with a metal and glass top plate and is equipped with a large scale with a range of 0-300 volts. The meter uses the D'Arsonval type of moving-coil movement and has a resistance of 1,000 ohms per volt.

Usage: For measuring the voltage output of "B" power-packs or other high-resistance DC circuits.

Outstanding features: It will accurately measure voltages in high-resistance circuits where the average voltmeter would be inaccurate. It is mounted in a case of convenient size and shape.

Maker: Hoyt Electrical Instrument Works.

A Self-Contained Storage "A" Battery and Charger

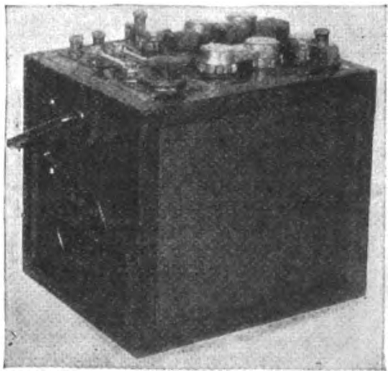
Name of instrument: "A" power unit.

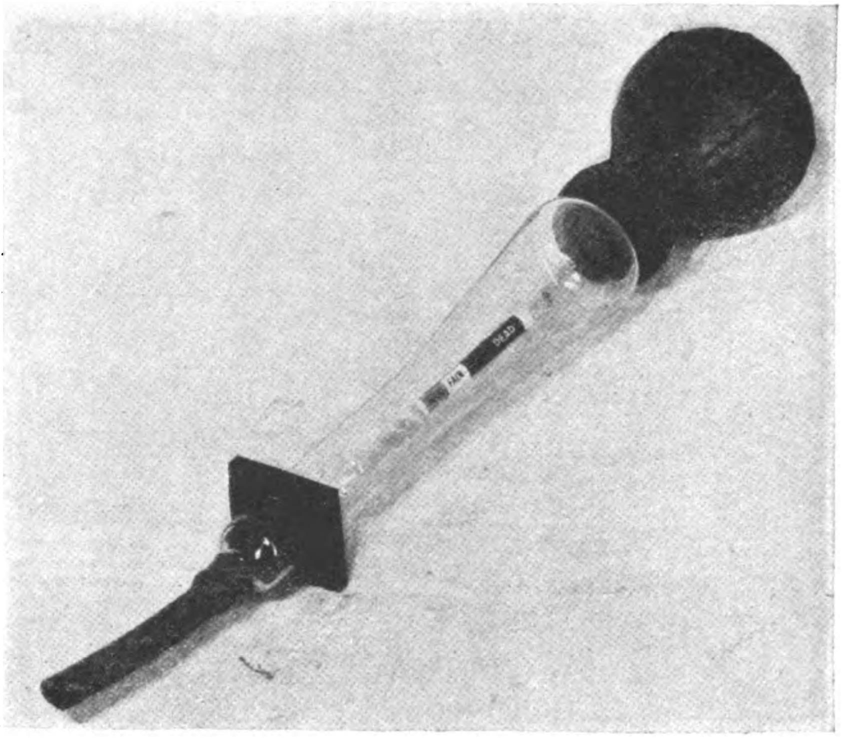
Description: A 6-volt storage battery and a trickle charger are enclosed in a single hard-rubber case. The trickle charger is of the electrolytic type, which supplies a sufficiently high current to keep the battery constantly charged. The instrument is provided with an indicator switch by means of which the trickle charger may be turned "on" and "off" at will. The operating cost of this unit is approximately the same as that of a 15-watt lamp—about one-sixth of a cent per hour.

Usage: To provide a constant supply for the filaments of any receiver.

Outstanding features: The battery and charger are combined in a single unit. It is provided with an "on-off" switch. The charging rate is adequate to keep battery fully charged.

Maker: The Cooper Corporation.





An Accurate Battery Tester

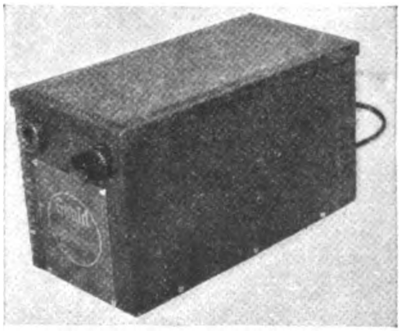
Name of instrument: Hydrometer.

Description: The shape of the barrel used in the construction of this instrument offers many advantages. The barrel is of heavy glass and is rather large in diameter near the bulb. The diameter gradually tapers toward the lower end, where it terminates in a nipple, over which a short length of rubber is slipped. A square rubber collar is fitted over the barrel to prevent the instrument from rolling. The rubber bulb is of heavy, springy rubber which provides strong suction. The float is designed in such a way as to cause it to stand upright when floating. The float scale is calibrated and is also marked into four colored sections to facilitate quick reading.

Usage: To test the specific gravity of the electrolyte in a storage battery, thus determining the state of charge of the battery.

Outstanding features: It is accurate, well protected against breakage and easy to read. The float will not stick to barrel.

Maker: Scranton Glass Instrument Co., Inc.



An Adjustable Voltage Supply Unit to Fit Your Receiver

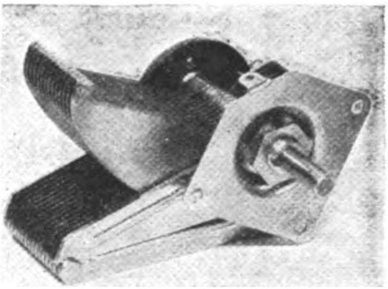
Name of instrument: "B" Unipower.

Description: This "B" power-pack makes use of a full-wave, gaseous type rectifier valve and supplies ample "B" power for the operation of any receiver that does not require more than 135 volts. Terminals are provided to supply three different "B" voltages to the receiver. There is a knob on the front of the device by means of which the detector "B" voltage can be regulated as required. Also an adjustment is provided to regulate the over-all "B" voltage output of the unit to fit the requirements of any particular receiver. The entire unit is inclosed in a neat metal case. As a safety measure a trigger switch is incorporated in the case so that the unit cannot operate when the cover is taken off the case. This prevents the user from touching any of the "live" parts of the unit while it is in operation. The "B" Unipower is designed primarily for use with the Gould "A" Unipower, and when so used it is turned "on" and "off" automatically with the receiver.

Usage: To supply all "B" voltages to a receiver which requires not more than 135 volts for the operation of a power valve, with a total current drain not exceeding 40 milliamperes. It can be used where the lighting-line supply is alternating current, rated at 110 volts, 50-60 cycles.

Outstanding features: It is completely inclosed and easy to operate. The output voltage is variable to fit the requirements of the receiver with which the unit is used. Special variable control is provided for the detector voltage.

Maker: Gould Storage Battery Co.



A Compact Tuning Unit

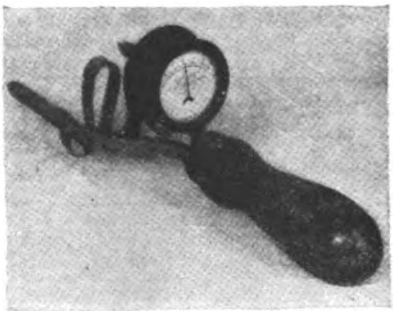
Name of instrument: Variable condenser.

Description: This straight-line-frequency condenser is sturdily made of brass plates with heavy-ribbed, metal end-plates. Insulation is provided by bakelite discs on which the bearings for the rotor are mounted. The stator plates are rigidly supported at three points. The rotor plates are crimped into a slotted shaft and the tips soldered into a slotted bar to maintain exact spacing. The condenser is designed for either single-hole mounting or for mounting by means of three screws through the panel, as desired.

Usage: For tuning the coils or transformers in a high-frequency circuit, or for any other purposes where a small variable capacity is required.

Outstanding features: It is compact size and rigid in construction. The plates are evenly spaced.

Maker: Benjamin Electric Mfg. Co.



A Simple and Clean Storage Battery Tester

Name of instrument: Storage battery voltage tester.

Description: This instrument consists of a wooden handle from which protrude two pointed, metal prongs. These prongs are connected together by means of a long zigzag strip of metal that acts as a current shunt, and a voltmeter is mounted with its terminals connected to the two prongs. When the pointed prongs are dug into the terminals of a cell of a storage battery, the metal strip is shunted directly across the cell, thus placing the cell under a heavy load. At the same time the voltmeter shows the voltage of the cell.

Usage: For testing the state of charge and general condition of the individual cells of a storage "A" battery.

Outstanding features: It is substantial construction and easy to use. It does not require the opening of the battery or the handling of the acid electrolyte of the battery.

Maker: Battery Equipment and Supply Co.

Increased Selectivity for Superheterodyne Receivers

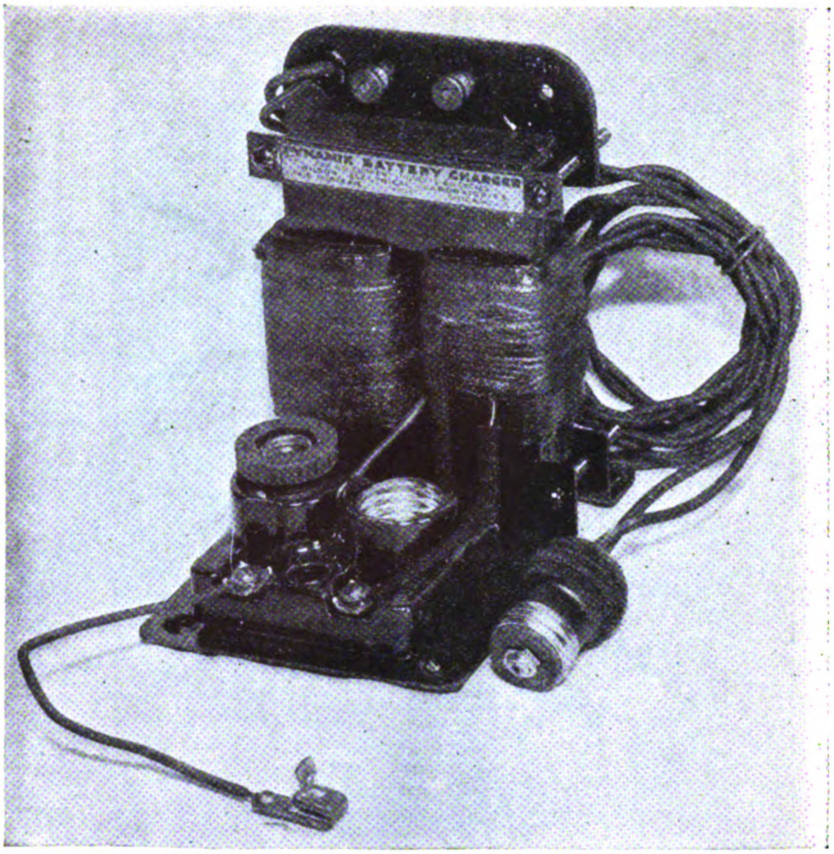
Name of instrument: Band-pass filter.

Description: This unit consists of a composition tube with flanged ends, upon which are wound two coils, each consisting of a large number of turns. The two ends of each coil-winding are brought out to soldering lug terminals. This filter is tuned by means of fixed condensers shunted across each of the windings. It may be tuned to frequencies anywhere between 20 and 80 kilocycles by using shunt capacities of the proper size.

Usage: When so tuned, this unit may be used as the filter transformer in the first or last stage of a superheterodyne intermediate-frequency amplifier, and will permit only the frequencies in a band 10 kilocycles wide to be amplified.

Outstanding features: When used in a long-wave amplifier, it will provide good selectivity without cutting sidebands, which would spoil the tonal qualities of reproduction. It can be used to advantage in most superheterodyne receivers in place of the present tuned (filter) transformer.

Maker: Samson Electric Co.



An Inexpensive Charger for Your Battery

Name of instrument: Banner (Dynamik) "A" battery charger, Model 750.*

Description: This unit consists of a Dynamik transformer mounted on a metal base, with a double porcelain receptacle with screw sockets for a rectifier valve of the 2½-ampere Tungar type and for a protective fuse. At the top of the transformer a terminal board is provided with binding posts for connection to the storage battery and with an extension cord and plug for connection to the lighting lines. As a matter of economy, this unit consists only of the essentials and is not enclosed in a metal case. The primary and secondary windings of the transformer are entirely separate and the battery may therefore be charged without disconnecting it from the receiver.

This make of charger is also obtainable in three other forms. One is similar to the Model 750, but is enclosed in a metal case, and another, Model 600, is a trickle charger with a charging rate of .6 ampere; the Model 650 is a 2½-ampere charger which may be used to charge 6 or 12-volt batteries or may be used to charge storage "B" batteries.

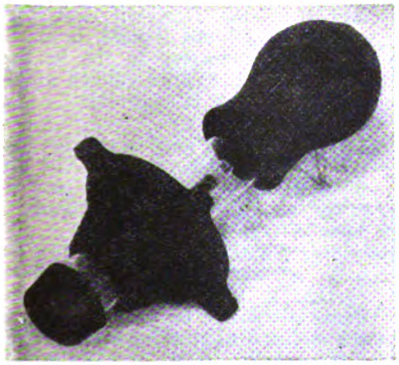
Usage: For charging storage batteries from the 110-volt, 60-cycle, house-lighting lines.

Outstanding features: It is quiet and satisfactory in operation and operates at a low cost. It is amply protected against short circuit. Types 750 and 600 do not require that the battery be disconnected from the receiver.

Maker: Banner Radio Laboratories.

---

* The name of this line of products has recently been changed from Dynamik to Banner.



A Battery Tester That Fits in the Battery Vent Hole

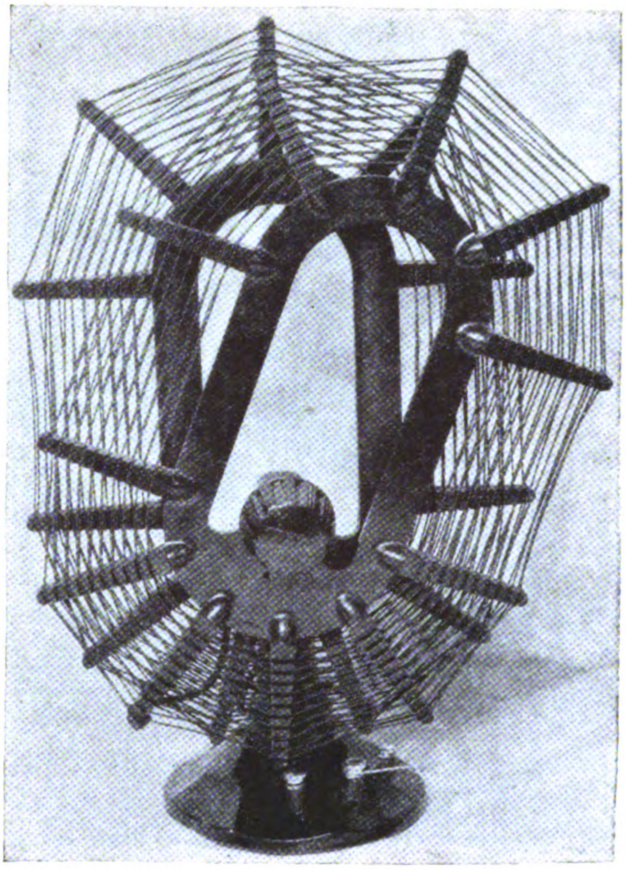
Name of instrument: Hydrometer.

Description: The barrel and float in this hydrometer are similar to those in standard hydrometers except that they are shorter. Instead of a long rubber tube to dip into the battery solution, the lower end of the glass barrel dips directly into the electrolyte. There is a large rubber collar around the barrel which serves as a stopper for the vent hole of the battery cell. This device is intended to be left in position in the vent hole of the cell at all times. When it is desired to test the battery, it is necessary to compress the bulb, release, and then take the reading in the usual way. In addition to showing the state of charge of the battery, this instrument shows when additional water is needed in the cells, because when the electrolyte level drops too low the end of the hydrometer will not be immersed and therefore a reading cannot be taken. The large rubber collar is of graduated diameter, so as to fit snugly in a vent hole of any size.

Usage: For testing the state of charge and the electrolyte level of a storage battery.

Outstanding features: It provides a reliable check on the condition of the battery and indicates when the battery needs water. It need never be removed from the battery vent holes except to permit addition of water to cells.

Maker: Scranton Glass Instrument Co., Inc.



A Loop Antenna That You Can Tune

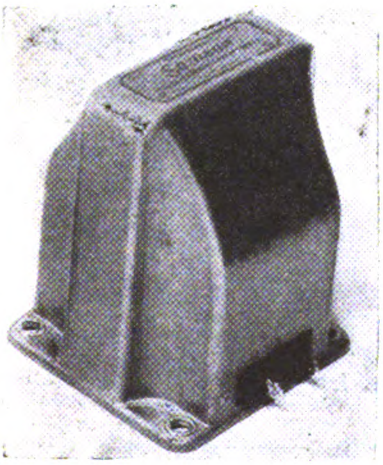
Name of instrument: "Tun-A-Loop."

Description: This loop antenna consists of two separate loop windings, so arranged that the position of one can be varied in its relation with the other, in this way varying the inductance of the entire unit. The two windings, in other words, act like a variometer. The frames upon which the wire is wound are of bakelite. The windings are of the spider-web type and are of silk-covered phosphor-bronze wire. The positions of the sections are varied by means of a knob on one of them. Three terminals are provided so that the loop may be used in circuits which require a center-tapped loop. There is a calibrated scale on the loop base for use in noting the settings of the loop.

Usage: As a coil antenna for use with any radio receiver that is capable of operation with a loop antenna.

Outstanding features: The inductance of the loop may be varied to match the loop tuning condenser used. Also, it may be varied until its inductance is such that the settings of the loop tuning condenser will approximately correspond, for a given wavelength, with those of the other tuned circuits in the receiver. Good efficiency. Carefully made.

Maker: English-Whitman Products, Inc.



This Transformer Provides Excellent Tone Quality

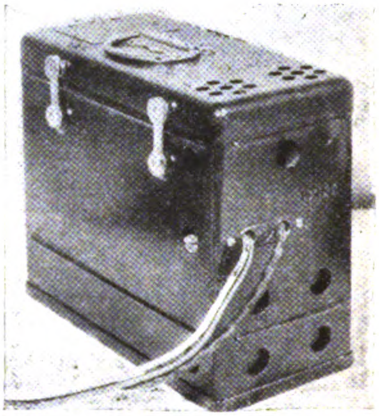
Name of instrument: Low-frequency amplifying transformer.

Description: The windings of this "symphonic" transformer are of the helical type and are mounted on a core of special high-permeability iron. The windings are large and the electrical design of the instrument is such as to provide uniform amplification characteristics at all frequencies throughout the musical range. The instrument is assembled in a metal case of neat appearance which measures 3⅛ by 2½ by 2⅞ inches over all. The terminals are placed close to the bottom of the case, two on the front side and two at the rear. A flange is provided at the bottom of the four corners; this is punched and eyeletted to accommodate the four mounting screws. The turns ratio is approximately 3 to 1.

Usage: As a device to provide coupling between the vacuum valves in a low-frequency amplifier.

Outstanding features: Provides very uniform amplification at all audible frequencies, with the result that reproduction, when used with a high-quality reproducer, includes the extremely low as well as the very high musical tones. New type iron core. High primary impedance. Low distributed-capacity windings.

Maker: Samson Electric Co.



An "A" Power Unit That Keeps Itself Fully Charged

Name of instrument: "A" power supply unit with a master control-switch.

Description: This unit, which is known as the Exide "Radio Power Unit, Model 3A," consists of a storage battery and trickle charger, both inclosed in a ventilated metal case. The charger is a standard type that makes use of a tungar rectifier valve. The unit has three adjustments to provide different charging rates. The battery is a standard 6-volt storage battery of comparatively small size. The unit is also obtainable in a 4-volt size for use with receivers that employ UX-199 type valves. The master control-switch is a separate unit and controls the "A" and the "B" supplies of a receiver in a single operation; that is, when the switch is thrown "on," the "A" unit is disconnected from the lighting lines and is connected to the receiver. The "B" power-pack, if one is used, is at the same time connected to the lighting lines. Thus the entire voltage supply for the receiver is controlled by this switch.

Usage: As a constant and dependable filament-current supply source. Will supply sufficient "A" current for any receiver regardless of the number of vacuum valves employed.

Outstanding features: The battery in the unit is automatically kept fully charged at all times. The unit requires absolutely no attention, except the addition of distilled water in the battery cells about once every six months. The operating cost of this unit when used in conjunction with a 5-valve receiver that is in use 2½ hours per day is approximately 2 cents per day. Compact in size.

Maker: The Electric Storage Battery Co.

A Detector That Requires No Adjustment

Name of instrument: Lebnite Multipoint fixed detector.

Description: This crystal detector is of the cartridge type. Its adjustment is fixed before it leaves the factory and no further adjustment is required on the part of the user. The crystal used is one that does not burn out when subjected to heavy voltage impulses; it should therefore have a long life.

Usage: As a detector in reflex circuits or any other circuits which are designed for the use of a crystal detector.

Outstanding features: It is easily installed in receiver and requires no special mounting. The adjustment remains fixed. The detector will not burn out.

Maker: Palmer & Palmer.

A Small Condenser That Is Easy to Install

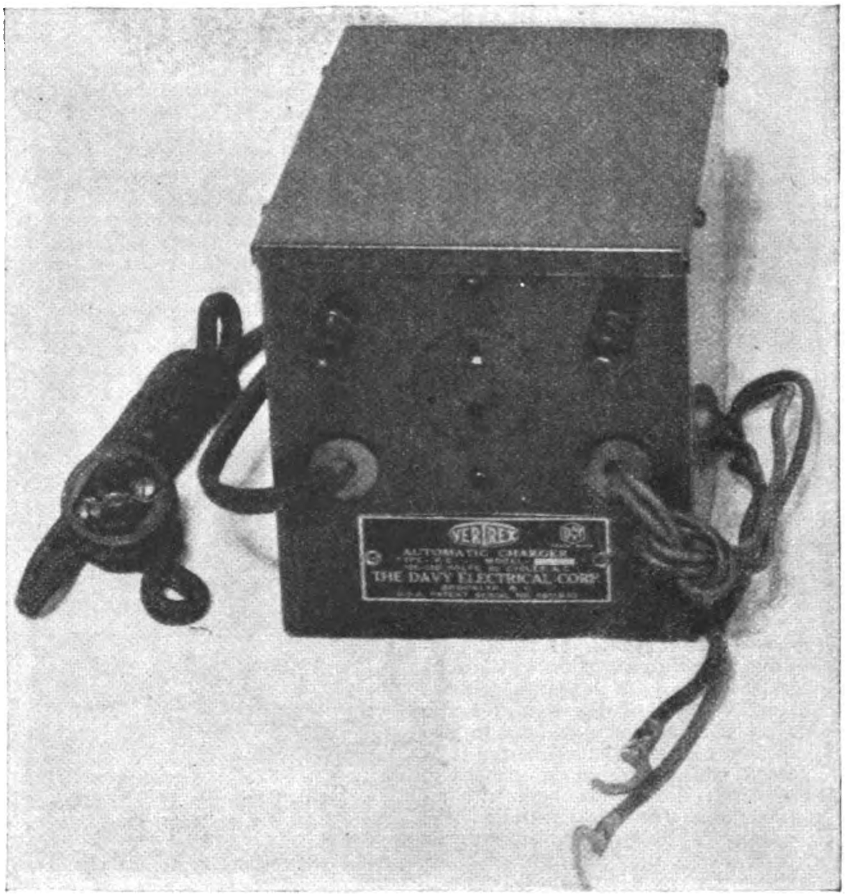
Name of instrument: Midget fixed condenser.

Description: This miniature fixed condenser is manufactured on the same principle as high-voltage filter condensers. It is of paper and foil construction thoroughly impregnated. The soldering lugs are assembled into the body of the condenser and are of flexible material, and therefore easily bent to any position desired. These lugs are tinned to facilitate soldering.

Usage: Wherever a capacity between .00007 mfd. and .1 mfd. is required in a circuit.

Outstanding features: It is small size and is designed for use where the working voltage is anywhere up to 1,000 volts. It is easily installed. The capacity is accurately rated.

Maker: Sprague Specialties Co.



A Trickle Charger That Requires No Attention

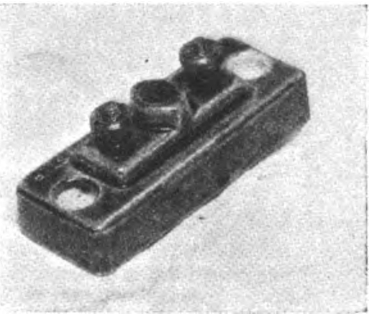
Name of instrument: Vertrex automatic charger.

Description: This charger is enclosed in a metal case with dimensions of 4¾ by 7 by 5 inches. This case contains the necessary transformer, a relay switch and the special Vertrex rectifier. This rectifier does not employ liquids, vibrators or vacuum valves of any kind. It requires no attention. It also has the added advantage that it rectifies both halves of the wave. The charging rate varies automatically with the state of charge of the storage battery. If the battery is practically discharged, the charging rate is in excess of 1 ampere. As the battery becomes normally charged, this rate drops accordingly. A receptacle is provided in the case into which the plug of a "B" power-pack may be inserted. Thereafter the control of the "B" power-pack and the trickle charger become automatic, in that when the receiver switch is turned "on" the charger is disconnected from the AC lines, the battery is connected to the receiver and the "B" power-pack is connected to the AC lines. When the receiver is turned "off," the action is reversed and the storage battery is put on "charge."

Usage: When used in conjunction with any standard 6-volt storage battery, it will keep the battery charged at all times. This unit operates from the 110-volt, 60-cycle lighting lines.

Outstanding features: It requires no upkeep expense or attention; it makes entire operation of the "A" and "B" voltages automatic.

Maker: Davy Electrical Corp.



A Compact Lightning Arrester

Name of instrument: Weatherproof lightning arrester.

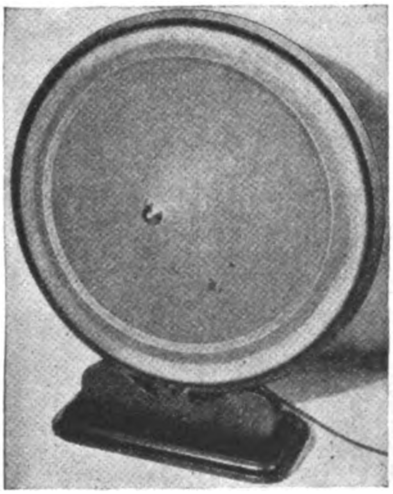
Description: This arrester consists of a molded porcelain case in which the protective element is carefully concealed. Terminals are provided in the form of binding posts on the top of the porcelain base and screw holes are provided for mounting screws. The over-all dimensions of this unit are 3 by 1¼ inches.

Usage: For installation in the antenna ground circuit to provide a path to the ground for lightning or extremely heavy static charges, thus protecting the receiver.

Outstanding features: It is approved by the National Board of Fire Underwriters, for use in either indoors or outdoors. It is fully protected from the weather, and is extremely small.

Maker: Kirkman Engineering Corporation.

What's New in Loudspeakers

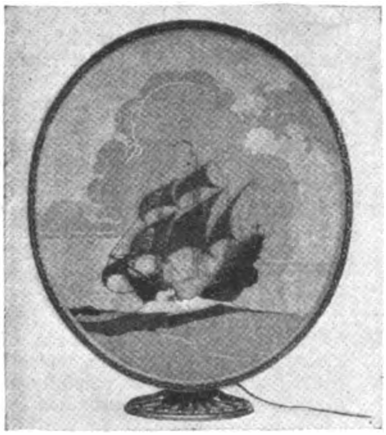


The New Stevens Conoidal Speaker, Model A

Description: This cone is of a moisture-proof fabric construction and is constructed in a single piece, without seams. It is of the semi-free-edge type, and the cone is crimped to give a more flexible action. The rim is of wood and is finished in mahogany. The unit is furnished both with an easel base (in the illustration the speaker is shown mounted on this base) and a silk hanging cord. The owner therefore has the choice of hanging the reproducer on the wall or using it with the base. The cone is 17½ inches in diameter.

Outstanding features: Strongly made, to hang on the wall or to stand on the table; neat in appearance, and provides good reproduction.

Maker: Stevens & Co.

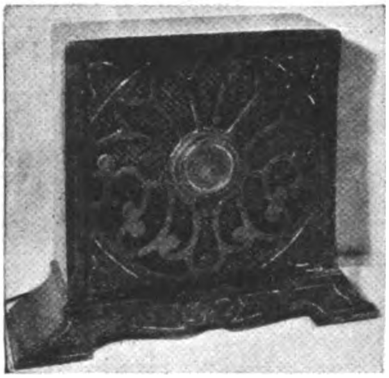


The New Timmons Cone

Description: This is a large-sized cone reproducer; the entire unit stands approximately three feet high and is equipped with an extra heavy metal base for greater stability. The cone is of parchment paper and is decorated with a well-executed ship scene. This method of decoration is a marked advance over the somber finish of most of the other large cones that are on the market. The driving rod is attached to the cone in an eccentric position, about half-way between the bottom and the center of the cone; this arrangement has the advantage that the long radius from the driving rod connection to the top of the cone permits the extremely low bass notes to be reproduced more freely, without cutting off the high notes, with the result that the reproduction curve is more uniform throughout the entire musical range.

Outstanding features: Great volume, good looking and marked with an even amplification curve.

Maker: Timmons Radio Corp.

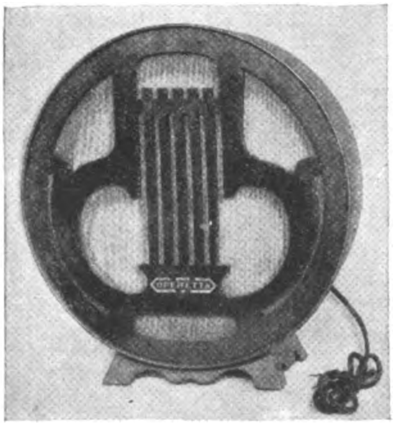


Spartan Disc Speaker, Model 100

Description: This reproducer has been designed to please the eye as well as the ear. The cabinet which encloses the disc is finished in walnut and has attractive lines. The front grill is finished to match and is backed up with silk. The cone is entirely concealed from view and from dust, and is of the floating type.

Outstanding features: Fully enclosed, neat appearance, and has good volume and tone quality.

Maker: Spartan Electric Corp.

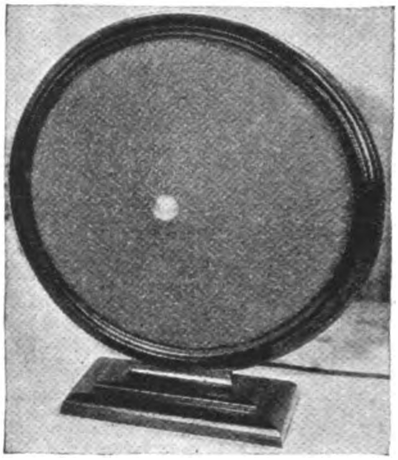


The New Operetta "Drum" Loudspeaker

Description: As the name implies, the case of this reproducer is drum-shaped and consists of an aluminum shell with a decorative wooden front grill backed with loosely woven gold cloth. The case is mounted on a heavy metal base and finished in bronze. The parchment cone is of the free-edge type.

Outstanding features: Compact and pleasing tone quality.

Maker: Victor Radio Corp.

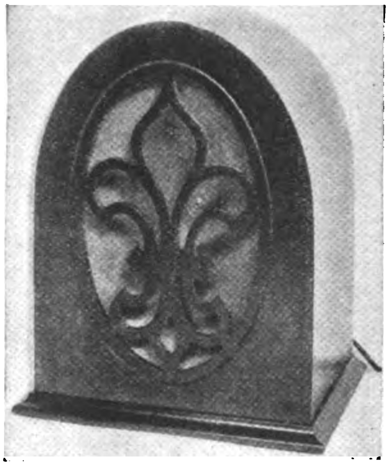


The New Spartan Junior Disc, Model 400

Description: This reproducer is unusual in that the disc, or cone, is of pith-wood composition instead of the usual parchment paper. The frame and stand are finished in mahogany. The rough surface of the disc is finished in a mottled effect, which lends attractiveness to the entire unit. This reproducer is unusually low-priced.

Outstanding features: Low in price, attractive in appearance, and has good volume—especially on low notes.

Maker: Spartan Electric Corp.

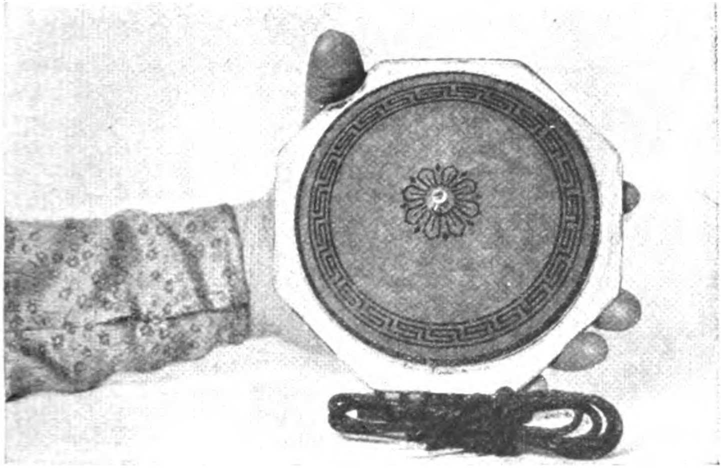


The New Brandes Cabinet Cone No. 1100

Description: This reproducer consists of an eliptical parchment cone enclosed in a neat cabinet that is finished in Adam-Brown, duo-tone mahogany. This cabinet not only serves as a housing for the delicate cone and operating mechanism, but also contains a tone chamber that tends to provide well-rounded tone quality. There is an adjustment on the unit to provide maximum sensitivity and clarity of reproduction.

Outstanding features: Small in size, with large volume and clear reproduction.

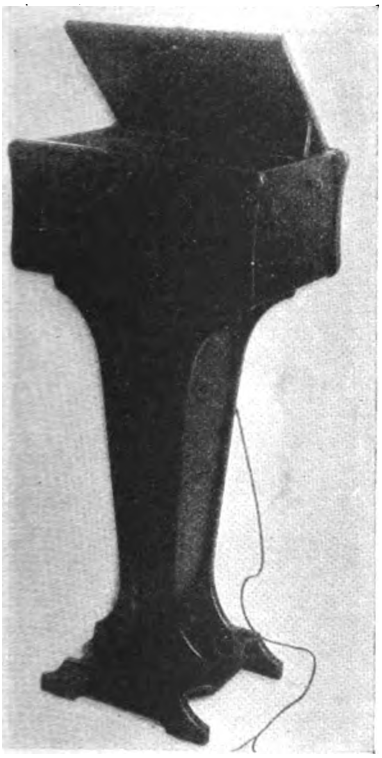
Maker: Federal-Brandes, Inc.



The Na-Ald Midget Cone Reproducer

Description: This is an unusual cone reproducer, chiefly in the matter of size. It is designed to fill a unique purpose and is not just a "trick." Its tiny volume is in proportion to its size; it is intended for use at times when great volume of reproduction is not desirable—such, for instance, as late at night when the family have gone to bed and the DX fan wants to listen in without waking the household. Another practical scheme is to use several of these units in different rooms. Their cost is low and a number of them may be installed for the price of one standard-sized reproducer. A specially made small unit is attached to a rod that drives the miniature paper cone. The edge of the cone is bound with felt and rests against the composition sounding board. The small composition base is finished to match the octagonal sounding board. It is a standard cone in all respects but size.

Maker: Alden Mfg. Co.

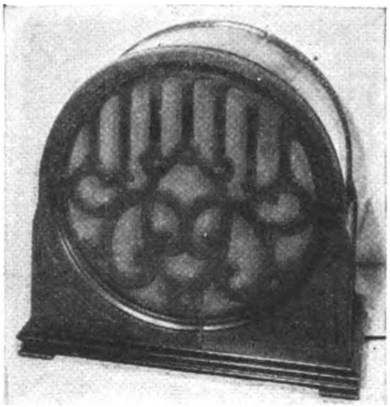


The New Wright-DeCoster, Model 101

Description: A unique note has been struck in the design of this reproducer, as is evident from the illustration. The long, tapering pedestal is actually a housing for a horn of special composition. The tip of this horn is near the bottom of the pedestal where the reproducer unit is attached. The large end of the horn opens into the box-shaped portion at the top of the stand. The hinged top cover serves as a sounding board and is adjustable to any desired angle. The principle of this adjustable feature is similar to that of the adjustable top on a concert grand piano. The reproducer stands on the floor and measures 35 inches in height, with the sounding board closed. The case is of black walnut, finished in a dark brown.

Outstanding features: Contains an exponential horn. Excellent quality of reproduction. Attractive in design. Equipped with a volume control.

Maker: Wright-DeCoster, Inc.

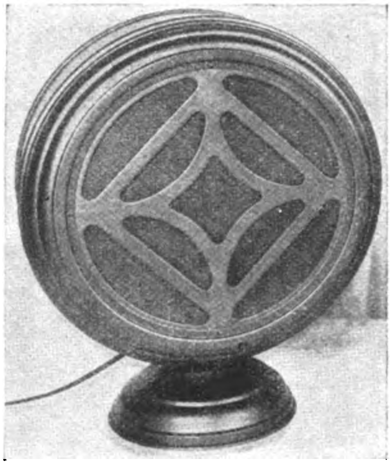


The New Amplion Cone, Model AC-12

Description: This cone reproducer is enclosed in a mahogany case, which serves as a decorative housing and also as a sound chamber to lend depth to the quality of reproduction. The front of the case is a wood grill backed with silk.

Outstanding features: Great volume. Clarity. Good-looking.

Maker: Amplion Corporation of America.

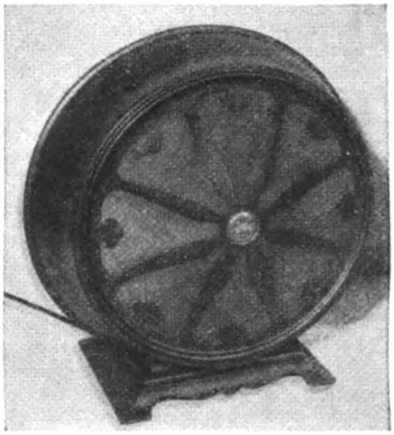


The New Wirt Cone Speaker

Description: This reproducer is of the free-edge cone type. It is enclosed in a metal case with a metal grill front. backed with silk. Provision is made at the back of the instrument for adjustment by means of a small knob to regulate the quality of reproduction. The entire instrument is finished in a pleasing bronze.

Outstanding features: Entirely enclosed in a metal case. Suitable for use with any set.

Maker: Wirt Co.



The New Baldwin "99"

Description: This model is enclosed in a metal container with an open metal grill at the front, lined with self-colored silk. The entire construction is finished in bronze. The reproducing assembly consists of a Baldwin balanced armature unit and a horn of special composition and design. The horn is unusual in form, and demonstrates excellent operating characteristics.

Outstanding features: Beautiful reproduction. Contains an efficient unit. Handles large volume without distortion.

Maker: Nathaniel Baldwin, Inc.

THE LATEST RADIO

VALVES

What they are, what they can do, how they rate and what they contribute to the progress of radio art.

Such rapid strides have been made—and are still being made—in the development of the vacuum tube that a new field is being opened to the experimenter and a new and better era of broadcast reception is promised to the fan. So important does POPULAR RADIO regard these new types of valves to the radio art that it has made a careful survey of the entire field and selected, tested and recorded the special features of the tubes of outstanding merit for the benefit of its readers of all classes.

By THE TECHNICAL STAFF

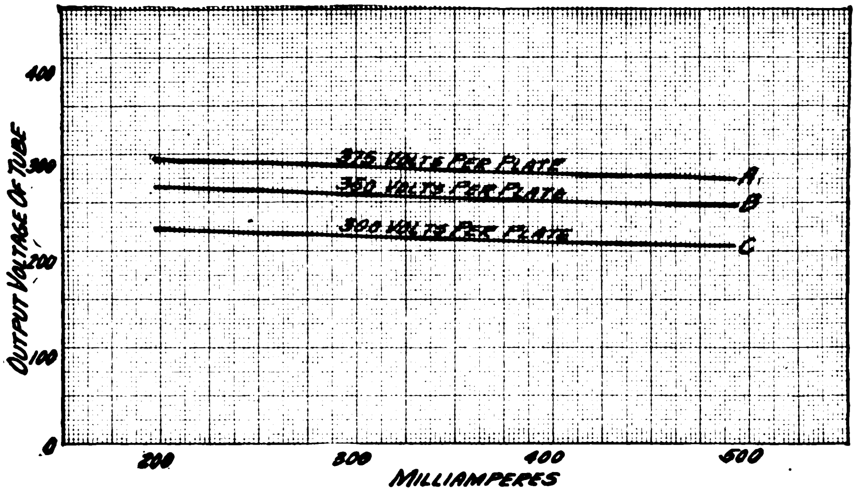
THE vacuum tube (more properly termed the "vacuum valve") is the very heart of the radio receiving set.

At no period in the entire history of radio have so many or such significant developments been made in these vacuum valves as during the past few months, or has such a variety of types of valves been placed at the disposal of radio experimenters and broadcast listeners as will be available at or about the time that this issue of POPULAR RADIO is published.

The vacuum valves used for radio reception contain, in general, three common elements:

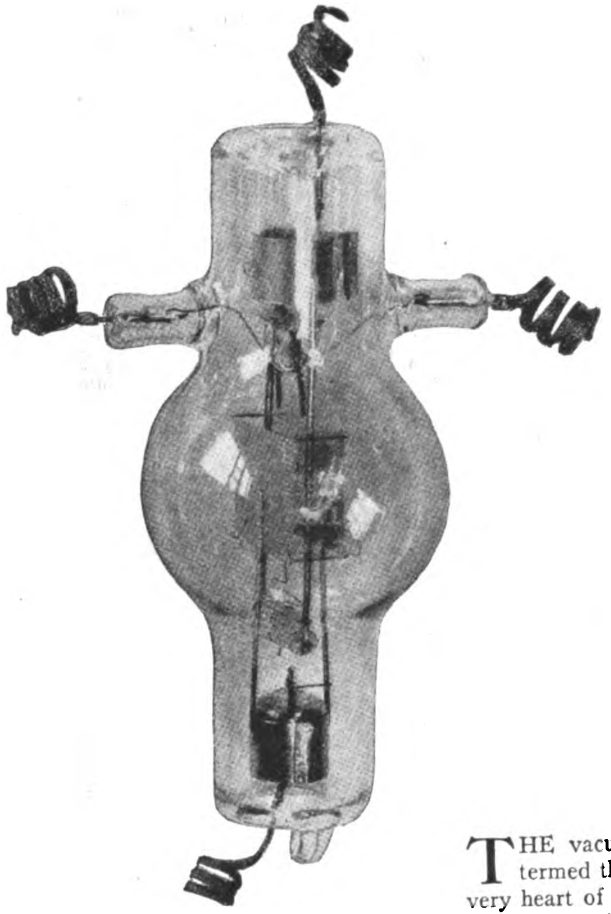
(1) The plate;
(2) The grid;
(3) The filament.

The main variation between the different kinds of valves lies in the size and shape of the plate, in the mechanical dimensions of the grid and its spacing between the plate and the filament, and in the kind of filament material that is used to emit the stream of electrons



THE VOLTAGE REGULATION OF THE Q. R. S. FULL-WAVE RECTIFIER VALVE

CHART 1: *These curves show the DC voltages of rectifier output obtainable at various current drains and at three different AC input voltages per anode (plate).*



A High-Power Transmitting Valve for Short Waves

Name of valve: Type "H" transmitting valve.

Description: This vacuum valve was especially designed for the needs of amateur transmission fans, particularly in transmitters that work on wavelengths below 100 meters. It is unusual in shape and its greatest merit for short-wave transmission lies in the fact that the four external leads are widely separated instead of being bunched at the base, as has been the practice in ordinary valve construction. The valve is shaped like a cross. The filament leads are brought out of the ends of the cross arms, while the plate and grid leads come out at opposite ends of the long section of the valve. This arrangement provides not only superior insulation, but also reduces internal capacity. The valve has no base; instead, the wire terminals may be connected directly to their proper points in the circuit.

Valve rating:
Filament voltage—10 (AC).
Filament current—2.35 amperes.
Plate voltage—500 to 2,000.
Plate current—50 to 100 milliamperes.
Maximum input—150 watts.

Usage: As an all-purpose transmitting valve.

Outstanding features: Provides good results on any voltage input between 500 and 2,000 volts. Extremely low internal capacity, an especially advantageous feature for transmission at wavelengths below 20 meters. No socket or base required.

Maker: DeForest Radio Co.

that does the work of amplification or detection.

In the descriptions of valves that follow, the proper voltages to be applied to the filament are given, as well as the correct filament currents; the standard plate voltages are also recorded, along with the proper grid-biasing voltages.

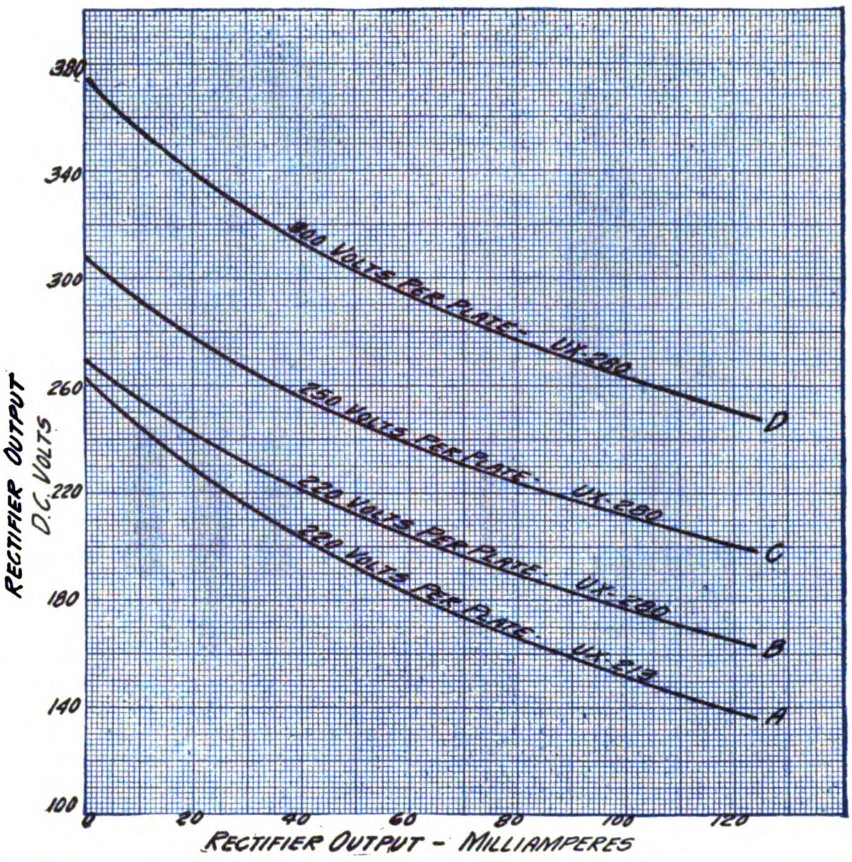
There are three other characteristics of an electrical nature which are essential to the engineer in picking out the type of valve that he wants to use for a specific purpose.

The first of these is the amplification factor, known as *mu*.

This factor is obtained by electrical measurement. It is the rate of change of plate current with grid voltage variation divided by the rate of change of plate current with plate voltage variation.

All that the layman need know about this factor is that it should be as high as possible, along with as low a plate impedance as is possible for general use.

The second electrical characteristic—the *plate impedance*—refers to the plate-circuit, AC resistance. It is the reciprocal of the rate of change of plate current with plate voltage variation for a complete AC cycle. The rate of change varies during the AC cycle.



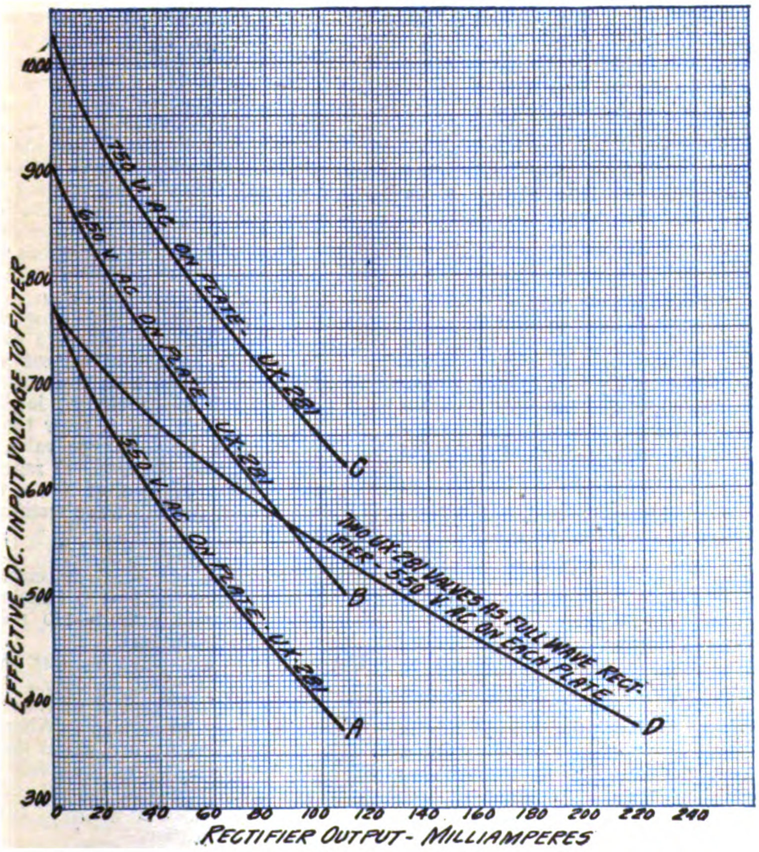
THE OPERATING CHARACTERISTICS OF THE UX-280 RECTIFIER VALVE

CHART 2: *Curves B, C and D show the DC output voltage of the UX-280 valve at various current drains. A comparison of curves A and B shows the superiority of the UX-280 over the UX-213 when used with the same AC input voltage.*

In a valve that is used for power amplification, the plate impedance should be as low as possible. For voltage amplification, however, the plate impedance may run to rather high values without loss of efficiency.

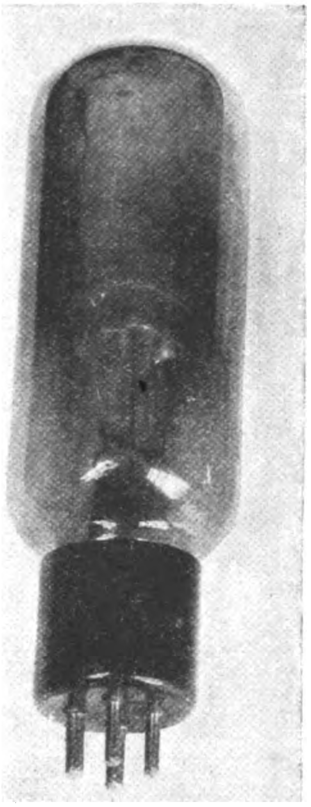
The third electrical characteristic that is necessary in determining good valves from poor ones is the *mutual conductance*, which may be termed a "figure of merit"; this depends very largely upon the emission characteristics of the filament. Good valves have the higher values of mutual conductance. The mutual conductance is the rate of change of plate current with grid voltage variation for a complete AC cycle. The rate of change varies during the AC cycle.

The detailed information about these new tubes, as presented to the experimenter by the POPULAR RADIO LABORATORY in the following pages, should enable him to determine which of the new valves listed will give him the greatest improvement in his present set.



THE OPERATING CHARACTERISTICS OF THE UX-281 HALF-WAVE RECTIFIER VALVE

CHART 3: *Curves A, B and C show the DC output with three different input voltage values. Curve D shows the output characteristics of two valves used for full-wave rectification.*



(*See* CHART 1)

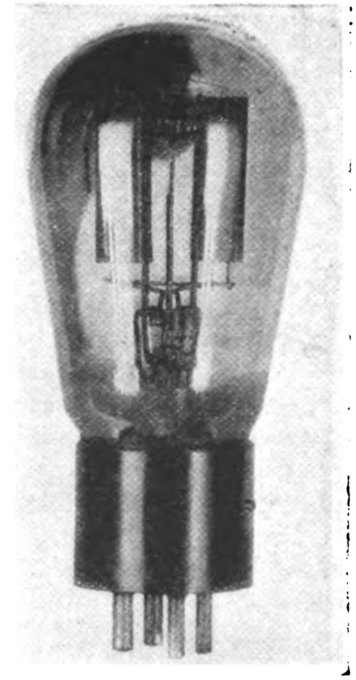
The New Q. R. S. 400-Milliampere, Full-Wave Rectifier Valve

Name of valve: Q. R. S. gaseous rectifier.

Description: In its outward physical dimensions this valve is similar to the standard 50-watt transmitting valve. It is cylindrical in shape and measures 7 inches in overall length by 2 inches in diameter. It is equipped with a standard UX type base and may be used with any standard socket. There are four terminals, as in the case of a standard vacuum valve; two of these are for connection to the high-voltage output of the supply transformer; the other two are connected to a low-voltage winding on the transformer which provides the ionization current required in the operation of this valve. A suitable transformer for use with this valve consists of a primary winding and three secondary windings. The center-tapped high-voltage secondary winding should provide 375 volts each side of the center-tap at .3 ampere; the ionizer winding should furnish 4 volts at 5 amperes; and the center-tapped filament winding should supply 5 volts at .5 ampere, for the filament of a power amplifier valve. Chart 1 shows the output curves of the rectifier at various loads.

Outstanding features: Furnishes full-wave rectification for "ABC" supply. Well constructed. Will meet the voltage demands of any receiver, including all filament currents and up to 180 volts for the plate power for a power amplifier valve. Will deliver up to 400 milliamperes without overloading.

Maker: Q. R. S. Music Company.



(*See* CHART 2)

Another New High-Power Valve for Full-Wave Rectification

Name of valve: Radiotron UX-280.

Description: This is a full-wave rectifier valve with characteristics similar to those of the UX-213, but it is intended particularly for use in "B" power-packs which must supply voltages and currents in excess of those obtainable with the UX-213 type rectifier valve. The UX-280 uses a ribbon-type, oxide-coated filament of rugged proportions, and is inclosed in a bulb of clear glass. It is equipped with a standard UX type of base.

This new rectifier valve may be substituted for the UX-213 type valve in existing "B" power-packs with a resulting large increase in voltage at a given current drain, as shown in curves A and B, Chart 2. Curves C and D of this figure show the output characteristics of this rectifier when used with higher AC input voltages up to the maximum of 600 volts (300 volts to each anode).

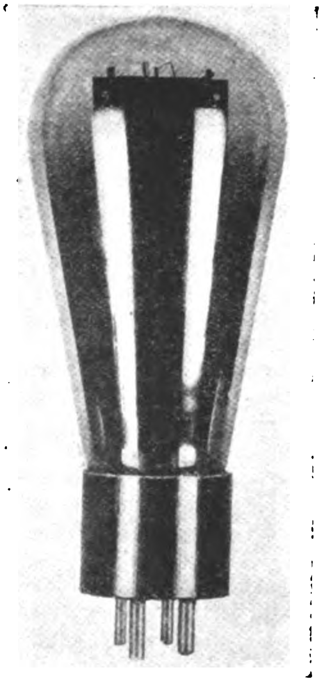
Valve rating:

Filament voltage—5, AC.
Filament current—2 amperes.
Plate voltage (AC)—300 to each plate (maximum).
Direct-current output—125 milliamperes (maximum).

Usage: As a full-wave rectifier in "B" power-packs which are required to provide a direct-current output not exceeding 125 milliamperes.

Outstanding features: Interchangeable with present UX-213 type rectifier valve. Can be used to provide much higher maximum current and maximum voltages than the UX-213 type. Requires smaller filter capacity than some of the other rectifier valves. Filament supply may be obtained from the filament winding of the power transformer that is also used to supply the high voltage.

Maker: Radio Corporation of America.



(*See* CHART 3)

A New Higher-Powered Rectifier Valve

Name of valve: Radiotron UX-281.

Description: This is a heavy-duty, half-wave rectifier that is similar in external appearance to the UX-216-b type valve. The new valve is capable of considerably greater output than is the 216-b, however. The UX-281 type valve is capable of supplying up to 110 milliamperes and is used with input voltages of from 550 to 750 as compared with the 65 milliampere current output and the input voltage limit of 550 for the UX-216-b rectifier valve. In existing "B" power-packs which make use of a UX-216-b rectifier the new valve may be used without any alterations whatsoever, and with higher voltage output at a given current drain.

Two of the UX-281 type valves may be used as a full-wave rectifier to provide an output current up to 220 milliamperes, with increased voltage at any given current load. In Chart 3, A, B and C show the output of the UX-281 type valve with various input voltages. D represents the output of two of these valves when used for full-wave rectification.

Valve rating:

Filament voltage—7.5, AC.
Filament current—1.25 amperes.
Plate voltage (AC)—750 (maximum).
Direct current output—110 milliamperes (maximum).

Usage: As a half-wave rectifier in "B" power-packs where an output current up to 110 milliamperes or voltages up to 600 may be required. Where current requirements are greater than 110 milliamperes, two of these valves will supply double the current of one, when connected in a circuit for full-wave rectification.

Outstanding features: Rugged construction. Interchangeable with the present UX-216-b rectifier. Permits use of AC input voltages up to 750, with correspondingly high output voltages.

Maker: Radio Corporation of America.

A Powerful Full-Wave Rectifier Valve

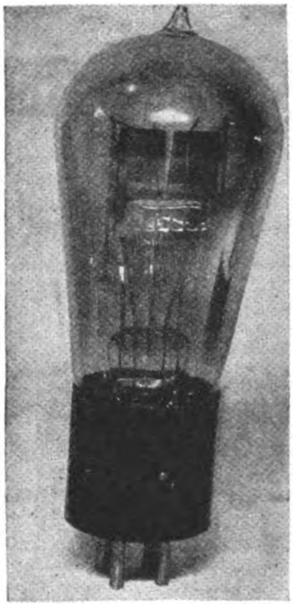
Name of valve: Donle DR-IV.

Description: This valve is of the high-voltage, full-wave rectifier type. It is somewhat similar in characteristics to the standard 216-b type of rectifier, but has the advantage that it rectifies both halves of the cycle instead of only one. The construction of the valve is extremely simple. In appearance it is much like that of the 216-b, but its plate is split into two halves to provide the double rectifying feature.

Usage: As a rectifier in a "B" power-pack that is required to furnish sufficient plate voltage for the operation of a UX-210 type of power amplifier valve.

Outstanding features: High voltage with full-wave rectification, a combination obtainable heretofore only with two rectifiers of the UX-216-b type of valve.

Maker: Donle-Bristol Co.



A Medium-Power Valve for the Last Stage

Name of valve: Champion, X-171.

Description: This power amplifier valve has the characteristics of the UX-171 type of valve.

Valve rating:

Filament voltage—5.
Filament current—.5 ampere.
Plate voltage—90 to 180.
Negative grid bias—Up to 40.5 volts.

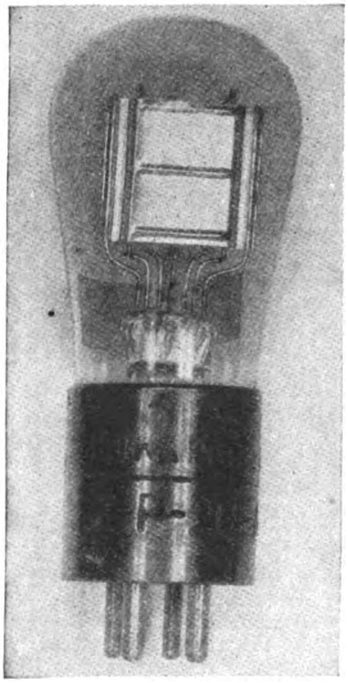
Valve characteristics (with plate voltage of 180 and negative grid bias of 40.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:

Plate resistance—2,980 ohms.
Amplification factor—3.3.
Plate current—11 milliamperes.

Usage: As a power amplifier where plate voltages up to 180 are available.

Outstanding features: When used in the last low-frequency stage of a receiver, it will withstand a high signal input without overloading, and will therefore produce great volume without distortion.

Maker: Consolidated Electric Lamp Co.



An Unusually Efficient Amplifier Valve

Name of valve: ZP-201-a.

Description: This valve is a standard 201-a type in size and shape. Its characteristics, when used as a low-frequency or high-frequency amplifier, are somewhat superior to those of the average 201-a valve, and when substituted for the standard 201-a type of valves in the amplifier stages of a receiver this superiority is quite noticeable. It is inclosed in a bulb of clear glass and is made under the special Zetka process of evacuation and conditioning.

Valve rating:

Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—45 to 135.
Negative grid bias—1½ to 6 volts.

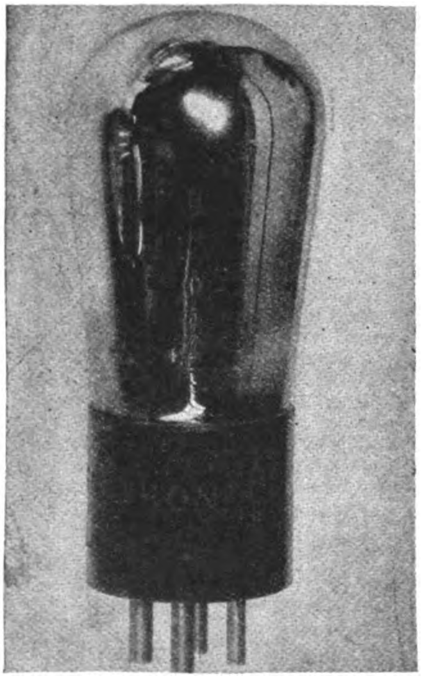
Valve characteristics (with plate voltage of 90 and negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:

Plate resistance—8,500 ohms.
Amplification factor—8.5.
Mutual conductance—990 micromhos.
Plate current—3.5 milliamperes.

Usage: May be used for any purpose for which a standard 201-a valve may be used, but is particularly recommended for use in high-frequency or low-frequency amplifiers.

Outstanding features: Superior amplifier characteristics. Clear glass bulb. Operates at full efficiency when there is considerably less than 5 volts on the filament.

Maker: Zetka Laboratories, Inc.



A Valve That Gives High Amplification

Name of valve: Magnatron, DC-240.

Description: This valve is especially suited for use in resistance-coupled, low-frequency amplifiers, on account of its high amplification factor. When so used, the amplification obtained is far superior to that obtained with the same amplifier using the UX-201-a type of valves. This valve is standard in size, shape and base.

Valve rating:

Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—90 to 180.
Negative grid bias—1.5 to 4.5 volts.
Plate coupling resistance—250,000 ohms.
Amplification factor—30.

Usage: As an amplifier where resistance coupling is used, or as a detector.

Outstanding features: When used in resistance-coupled amplifiers this valve provides amplification per stage approximately equal to that obtained with transformer-coupled amplifiers that employ the UX-201-a type of valves.

Maker: Connewey Electric Laboratories.

A Useful Rectifier Valve That Contains No Filament

Name of valve: "Speed" gaseous rectifier.

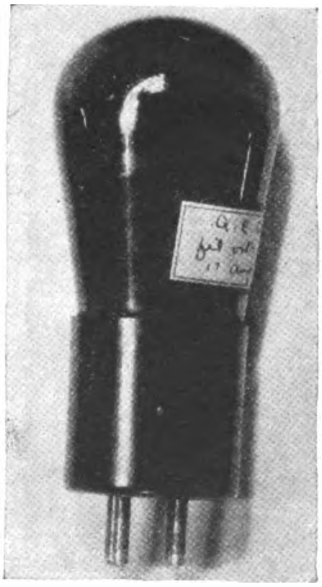
Description: This valve has the standard shape and size of its type, and is equipped with a standard UX-type base. The bulb is made of clear glass. It does not use a filament.

Valve rating:
Input voltage (AC)—300 (maximum).
DC output current—85 milliamperes (maximum).

Usage: As a full-wave rectifier in any standard "B" power-pack that requires a gaseous rectifier valve.

Outstanding features: Full-wave rectification. No filament to burn out.

Maker: Cable Supply Co., Inc.



A New Vacuum Valve with an AC Filament

Name of valve: VanHorne AC valve.

Description: This valve operates with "raw" alternating current applied to its filament. It contains the usual three elements, but uses an oxide-coated filament that is shorter, thicker and of lower resistance than the usual filament in 5-volt DC valves. This filament draws a heavy current at 1 volt, which is its proper operating voltage. The alternating current for the filament is obtained from the house-lighting lines through the use of a step-down transformer.

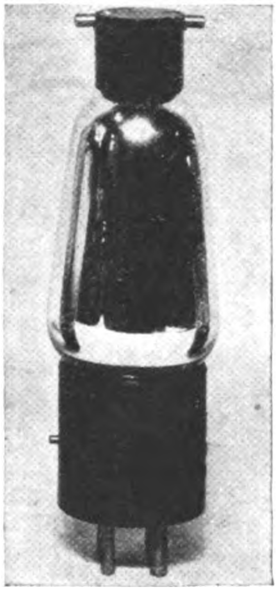
Valve rating:
Filament voltage—1.
Filament current—2.0 amperes.
Plate voltage—90 to 157.5.
Negative grid bias—Up to 9 volts.

Valve characteristics (with plate voltage of 90 and negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:
Plate resistance—10,580 ohms.
Amplification factor—9.9.
Mutual conductance—1,000 micromhos.
Plate current—3.4 milliamperes.

Usage: In either high-frequency or low-frequency amplifiers. When used in standard receivers, in place of the UX-201-a type of valves, some changes in the wiring of the receiver are required.

Outstanding features: Eliminates the need for a storage battery. Operates efficiently and practically without hum.

Maker: VanHorne Co.



The Pioneer Among the AC-Operated Valves

Name of valve: McCullough AC valve, type 401.

Description: This AC valve does not require the use of an "A" battery, but draws its "A" current from the AC house-lighting lines through a small step-down transformer. The alternating current is applied to an element in the valve called the "heater." This heater is placed sufficiently close to the cathode of the valve to cause the required electron emission from the latter element, but without causing any disturbing influence such as would result from the application of alternating current directly to the cathode. A standard base is used on the 401 valve, although only three of its terminals are used. The AC supply for the "heater" is applied at two terminals which are mounted on a composition cap at the top of the valve. The AC leads are kept well away from the valve circuit terminals, thus avoiding hum.

Valve rating:
Heater voltage—3 (AC).
Heater current—1 ampere.
Plate voltage—150 (maximum).
Negative grid bias—0 to 9 volts.

Valve characteristics (with plate voltage of 90 and negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:
Plate resistance—10,600 ohms.
Amplification factor—8.5.
Mutual conductance—800 micromhos.
Plate current—2.62 milliamperes.

Usage: Suitable for any usage to which standard 201-a type valves can be applied.

Outstanding features: Good characteristics. No storage battery required for filament heating. Sturdily built. Long life.

Maker: McCullough Sales Co.

A Powerful New Half-Wave Rectifier Valve

Name of valve: DR Rectifier.

Description: In size and general external appearance this valve is similar to the standard UX-216-b type of rectifier, except that the DR valve is equipped with a standard isolantite base. It is a half-wave rectifier and is intended particularly for use in a transmitting circuit that employs the DeForest type D transmitting valve. It can also be used in a "B" power-pack to supply direct current for a receiver which includes a power-amplifier valve in the last low-frequency stage.

Valve rating:
Filament voltage—7.5.
Filament current—2.0 amperes.
Plate voltage (AC)—550 (maximum).
Direct-current output—75 milliamperes (maximum).

Usage: As a rectifier for any purpose where the current drain does not exceed 75 milliamperes and the input voltage does not exceed 550.

Outstanding features: When used with suitable filter circuit will supply sufficient plate current for any receiver, including those using power amplifiers. Isolantite base.

Maker: DeForest Radio Co.

A Valve That Needs No "A" Batteries

Name of valve: Sovereign AC Tube.

Description: This valve does not require a storage battery, a dry battery, a rectifier or a filter for its filament supply. It is operated from the AC lines, through a small step-down transformer. A receiver equipped with these valves, and used in conjunction with a standard "B" power-pack, will not require the use of any batteries at all.

The valve is equipped with a standard base and can therefore be used in any standard UV- or UX-type sockets. Its main difference in appearance from that of the standard UX-201-a type of valve lies in the composition cap at the top of the valve. This cap is equipped with binding-post terminals for the heater element. The heater has as its sole purpose the heating of the cathode. Thus, instead of requiring the catnode to function both as a heater and as an emitter of electrons, as is the case in all standard valves, these functions are served by two separate elements in this AC valve. The heater element is placed close enough to the cathode to provide it with the necessary heat to cause suitable electron emission without introducing the hum that would probably result if raw alternating current were applied directly to the cathode. In its operating characteristics the Sovereign AC valve is almost identical with the standard UX-201-a type of valve.

Valve rating:
Heater voltage—3 (AC).
Heater current—1.1 amperes.
Plate voltage—22.5 to 160.
Negative grid bias—0 to 6 volts.

Valve characteristics (with a plate voltage of 90 and a negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:
Plate resistance—12,500 ohms.
Amplification factor—8.5.
Mutual conductance—680 micromhos.
Plate current—3.7 milliamperes.

Usage: As a detector, high-frequency or low-frequency amplifier in any receiver that is properly wired for the use of this valve. These valves can be used in place of UX-201-a type of valves in standard receivers through a modification of the filament wiring of the circuit.

Outstanding features: Eliminates the necessity for storage batteries or "A" power-packs. Requires only the use of a small and inexpensive step-down transformer to provide the low-voltage alternating current for the heater supply. Good construction and operating characteristics.

Maker: Sovereign Electric & Mfg. Co.

A Detector Valve That Improves Quality of Reproduction

Name of valve: Quality detector valve, type 150-d.

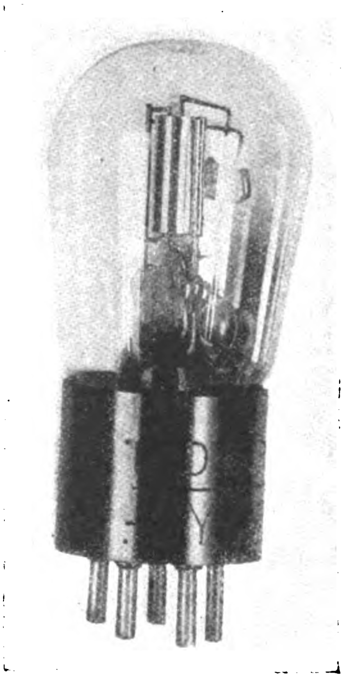
Description: This detector has the same filament requirements as the UX-201-a or UX-200-a type valves, and is therefore interchangeable with them. It is made expressly for use as a detector where the best tone quality is desired. It will not provide as great volume on weak signals as will detectors of the UX-200-a type, and is therefore recommended particularly for use in the reception of local programs. It is equipped with a standard UX-type base. For best results with this valve, it is important that the proper grid-leak value be used.

Valve rating:
Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—20 to 80.
Grid condenser—.00015 to .00025 mfd.
Grid-leak—.5 to 2 megohms.

Usage: As the detector for use in any receiver that is equipped for the use of a 5-volt valve for this purpose, in cases where maximum tone quality is more desired than great sensitivity and volume.

Outstanding features: Extremely quiet in operation. Not easily overloaded. Interchangeable with any 5-volt, ¼-ampere valve.

Maker: Magnavox Co.



The New 5-Prong RCA "AC" Valve

Name of valve: Radiotron UY-227.

Description: Alternating current, drawn direct from the house-lighting lines through a small step-down transformer, is used to supply the heater element of this new valve. The heater element is independent of the other elements of the valve, but is placed in close proximity to the emitter element (the cathode, which corresponds to the filament in a standard valve). The alternating current is therefore confined to the heater and has no effect on the other elements, such as might cause an AC hum. This valve is inclosed in a bulb of clear glass, similar in shape to the UX-201-a type valve. The base is of the new "UY" design, with *five* contact prongs. It requires a special socket. The characteristics of this valve, both as a detector and as an amplifier, are much like those of a standard UX-201-a type valve. The UY-227 type valve is therefore useful as a detector, high-frequency amplifier or low-frequency amplifier.

Valve rating:
Heater voltage—2.5 (AC).
Heater current—1.75 amperes.
Plate voltage—45 to 180.
Negative grid bias—0 to 13.5 volts.

Valve characteristics (with plate voltage of 90 and negative grid bias of 4.5 volts).
Plate resistance—11,300 ohms.
Amplification factor—7.9.
Mutual conductance—730 micromhos.
Plate current—3 milliamperes.

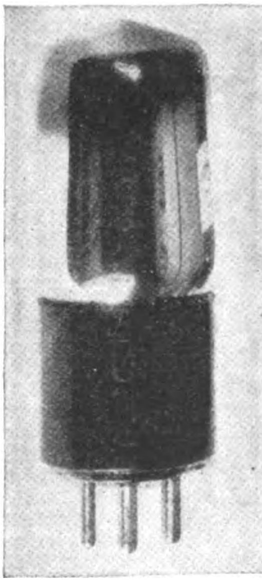
Usage: As an all-purpose valve for detection, low-frequency amplification or high-frequency amplification.

Outstanding features: Requires no storage battery or "A" power-pack for its filament supply. Introduces no AC hum into reception, even when used as a detector. May be used as a detector in a receiver that is designed for the use of Radiotrons UX-226 as amplifiers. Similar in characteristics to the UX-201-a type.

Maker: Radio Corporation of America.

A Detector Valve of Increased Sensitivity

Name of valve: Champion, UX-200-a.
Description: This is a detector valve of the standard UX-200-a type. The base is of the UX type and the bulb is of clear glass.
Valve rating:
Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—45.
Grid-leak—.5 to 2.0 megohms.
Grid condenser—.00025 mfd.
Usage: As the detector in any circuit or receiver that uses a detector valve with a 5-volt, .25-ampere filament.
Outstanding features: Extremely sensitive to weak signals.
Maker: Consolidated Electric Lamp Co.

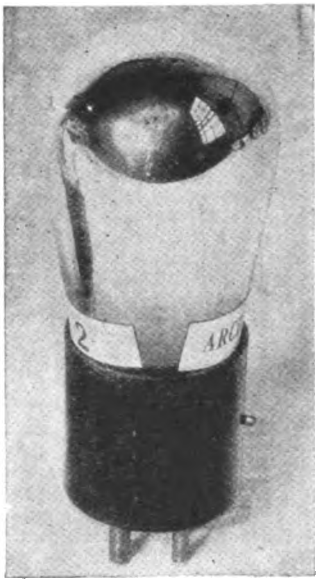


A Sturdy Vacuum Valve for Standard Use

Name of valve: Universal 201-a type.
Description: This is a general-purpose valve of the UX-201-a type, but it has the general appearance of all Magnavox valves. It is equipped with a standard UX-type base. It is designed for low internal capacity.
Valve rating:
Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—45 to 135.
Negative grid bias—0 to 9 volts.
Valve characteristics (with a plate voltage of 90 and a negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:
Plate resistance—9,400 ohms.
Amplification factor—7.9.
Mutual conductance—840 micromhos.
Plate current—3.5 milliamperes.
Usage: As an all-purpose valve for use in circuits where a standard UX-201-a type valve can be employed.
Outstanding features: Low internal capacity.
Maker: Magnavox Co.

A New Low-Current Valve

Name of valve: ZP-100.
Description: This is a new vacuum valve for which the radio fan has long waited. Its characteristics, when used as a detector tube or as a high-frequency amplifier or a low-frequency amplifier, are similar to those of the standard UX-201-a type valve, yet the filament-current consumption is only slightly higher than that of a UX-199 type valve. This means that a "B" power-pack can be readily used to supply the "A," "B" and "C" voltages for a multi-valve receiver in which these new valves are used, with their filaments connected in series. Also, these valves may be used in many of the standard receivers, in place of the UX-199 type valves, to be operated from dry cells. Or in receivers which use the UX-201-a type valves the new Zetka valves can be substituted with a resulting decrease in filament-current consumption of 60 per cent. One of the drawbacks to ordinary 5-volt, low-current consumption valves in the past has been that of short life. These ZP-100 valves are absolutely guaranteed to give satisfaction to the consumer, and this guarantee applies to their life as well as to their characteristics. The valve is similar to the UX-201-a type valve in size, shape and base. It differs from this type, however, in that the bulb is of clear glass and, while in operation, the filament burns with a dull red glow that can hardly be seen. The high efficiency of this valve, in spite of the low filament-current consumption, is a result of the method and materials used in coating the filament, plus the Zetka process of evacuation and of conditioning.
Valve rating:
Filament voltage—5.
Filament current—0.1 ampere.
Plate voltage—22½ to 135.
Negative grid bias—0 to 4.5 volts.
Valve characteristics (with plate voltage of 90 and negative grid bias of 3 volts), as determined in POPULAR RADIO TESTING LABORATORY:
Plate impedance—13,000 ohms.
Amplification factor—9.6.
Mutual conductance—740 micromhos.
Plate current—2.3 milliamperes.
Usage: As detector, high-frequency amplifier and low-frequency amplifier.
Outstanding features: Good operating characteristics. Low filament current. Excellent for use with filaments in series, to operate from the output of a suitable "B" power-pack.
Maker: Zetka Laboratories.



An Excellent Medium-Power Valve

Name of valve: Archatron, type 112.
Description: This valve is a typical UX-112 type in appearance and base. In its manufacture a special evacuation process is used which provides unusually high exhaustion.
Valve rating:
Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—90 to 157.5.
Negative grid bias—4.5 to 10.5 volts.
Valve characteristics (with a plate voltage of 157.5 and a negative grid bias of 10.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:
Plate resistance—3,900 ohms.
Amplification factor—5.7.
Mutual conductance—1,490 micromhos.
Usage: As an amplifier for use in the last low-frequency stage.
Outstanding features: Provides greater volume than does the UX-201-a type of valve, without overloading, when used in the last low-frequency stage.
Maker: Ken-Rad Corp.

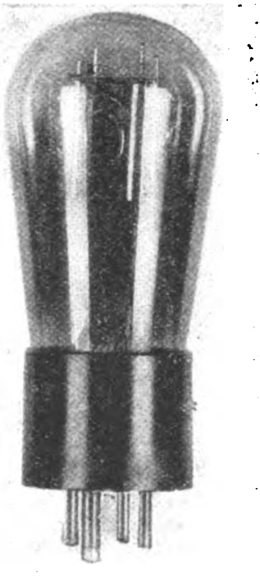
The New RCA "AC" Valve

Name of valve: Radiotron UX-226.

Description: This valve has practically the same operating characteristics as the UX-201-a type valve, but its outstanding advantage lies in the fact that its filament is heated by means of alternating current, rather than from direct-current supply. The alternating current for the filament supply is obtained from the AC lighting line through the use of a small step-down transformer to change the voltage to 1½ volts. It is not interchangeable with the UX-201-a type valves in a receiver unless rather extensive alterations are made in the wiring of the receiver. In a receiver especially designed and constructed for the use of these valves as amplifiers the results obtained will be comparable with those obtained from any standard receiver which uses an equal number of UX-201-a type valves.

Valve rating:
Filament voltage—1.5 (AC).
Filament current—1.05 amperes.
Plate voltage—90 to 180.
Negative grid bias—6 to 13.5 volts.

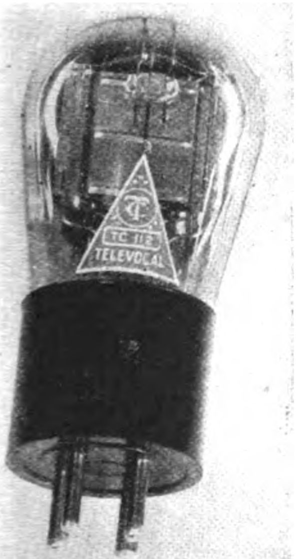
Valve characteristics (with plate voltage of 90 and negative grid bias of 6 volts):
Plate resistance—9,400 ohms.
Amplification factor—8.3.
Mutual conductance—880 micromhos.
Plate current—3.7 milliamperes.



Usage: As either low-frequency or high-frequency amplifiers. *Not to be used as detector.*

Outstanding features: The filament operates on raw alternating current. Characteristics similar to those of standard UX-201-a type valves. Eliminates the necessity for a storage battery or "A" power-packs.

Maker: Radio Corporation of America.



A New Non-Microphonic Power Valve

Name of valve: TC-112.

Description: This valve has the same size and appearance as the standard UX-112 type valve. Its characteristics also resemble the standard UX-112 type valve. It makes use of a special supporting plate for the valve elements to prevent short-circuiting of elements and to reduce microphonic effect.

Valve rating:
Filament voltage—5.
Filament current—.5 ampere.
Plate voltage—90 to 157.5.
Negative grid bias—4.5 to 10.5 volts.

Valve characteristics (with a plate voltage of 157.5 and a negative grid bias of 10.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:
Plate resistance—3,700 ohms.
Amplification factor—7.4.
Mutual conductance—1,930 micromhos.
Plate current—12 milliamperes.

Usage: As an amplifier in the last low-frequency stage.

Outstanding features: Non-microphonic. Gives good volume without distortion.

Maker: Televocal Corp.

A Detector Valve That Will "Pep Up" Your Reception

Name of valve: Super-Sensitive Detector, 200-a type.

Description: This valve is intended especially for use as a detector to provide greater sensitivity than is obtainable when the UX-201-a type of valve is used. It is slightly smaller in size than standard 5-volt valves and is of the distinctive Magnavox shape. The base is the standard UX type.

Valve rating:
Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—45.
Grid condenser—.00025 mfd.
Grid-leak—2 to 5 megohms.

Usage: As the detector in any receiver that is equipped for the use of a 5-volt valve for this purpose.

Outstanding features: Greater sensitivity than the UX-201-a type valve when used as a detector. Comparatively quiet in operation. Interchangeable with UX-201-a type of detectors. Gives increased volume.

Maker: Magnavox Co.

A General-Purpose Valve

Name of valve: DL-2.

Description: This is a standard type of vacuum valve. It is equipped with standard UX-type isolantite base. It is intended for use as a detector or as a high-frequency or low-frequency amplifier. The use of a cushioned socket is recommended for mounting this tube.

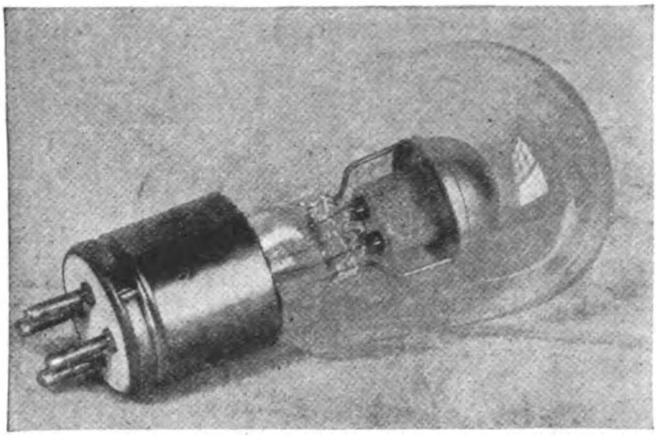
Valve rating:
Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—16.5 to 157.5.
Negative grid bias—0 to 9 volts.

Valve characteristics (with a plate voltage of 90 and a negative grid bias of 4½ volts):
Plate resistance—8,000 ohms.
Amplification factor—6.3.
Mutual conductance—780 micromhos.
Plate current—4.7 milliamperes.

Usage: As a detector, high-frequency amplifier or low-frequency amplifier.

Outstanding features: Particularly suitable for use in oscillating circuits in either the detector stage or high-frequency stage, because of smooth control of oscillation.

Maker: DeForest Radio Co.



The New Raytheon Model BA, 350 Milliampere Rectifier Valve

Description: This is a full-wave rectifier valve of the gaseous type; it is similar to the Raytheon BH rectifier valve in appearance, but slightly larger and of somewhat heavier construction. It is equipped with a standard UX-type base, which permits its use in any standard valve socket. While it has the usual four contact prongs, only three are used, as this valve has no filament or "heater" of any kind. The high-voltage alternating current which is applied to this valve to be rectified is obtained through a step-up transformer with a center-tapped secondary capable of supplying 320 volts, each side of center-tap; and a smaller winding capable of supplying 5 volts at .5 ampere for the filament supply of a power valve.

Outstanding features: Furnishes full-wave rectification for "ABC" power packs. With a proper transformer and filter, this valve will deliver a maximum current of 350 milliamperes at approximately 200 volts. Well designed and well made.

Maker: Raytheon Manufacturing Co.

A Detector Valve That Is Highly Sensitive

Name of valve: SX-00-a.

Description: In physical appearance this valve is identical with the standard UX-201-a type, and it is equipped with a standard UX-type base. The internal construction differs from the UX-201-a type, however, and instead of being evacuated as highly as possible this valve has a certain gas content which is one of the reasons for its great sensitivity as a detector.

Valve rating:

Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—45.
Grid-leak—2 megohms.
Grid condenser—.00025 mfd.

Usage: As a detector in any circuit or receiver which permits the use of a 5-volt, .25-ampere valve.

Outstanding features: A super-sensitive detector. Non-critical as to filament and plate voltages.

Maker: Sylvania Products Co.

A Dry-Cell Type of Valve

Name of valve: DL-3.

Description: The DL-3 is a dry-cell valve that corresponds in its operating characteristics to the standard UX-199 type of valve. It is provided with a standard UX-type isolantite base and and measures 3½ inches in overall height. The base is equipped with a pin, so that this valve may be used in either the old or new types of sockets. It may also be mounted in either a horizontal or vertical position.

Valve rating:

Filament voltage—3.
Filament current—.065 ampere.
Plate voltage—16.5 to 90.
Negative grid bias—0 to 4.5 volts.

Valve characteristics (with a plate voltage of 90 and a negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:

Plate resistance—21,000 ohms.
Amplification factor—8.0.
Mutual conductance—380 micromhos.
Plate current—1.8 milliamperes.

Usage: As a detector, high-frequency amplifier or low-frequency amplifier.

Outstanding features: May be mounted in any position. Less microphonic than the average dry-cell valve. May be mounted in any standard socket.

Maker: DeForest Radio Co.

A Standard Valve With a High Amplification Factor

Name of valve: SX-201-a.

Description: Isolantite is used throughout as an insulator in this valve. Not only is the UX-type base made of this material, but also it is used to support the filament and to reinforce the grid and plate structure within the valve. In shape and size this valve corresponds with the standard UX-201-a type, and its characteristics are such as to make it interchangeable with the standard valves in a receiver.

Valve rating:

Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—22.5 to 150.
Negative grid bias—0 to 9 volts.

Valve characteristics (with a plate voltage of 90 and a negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:

Plate resistance—15,000 ohms.
Amplification factor—10.1.
Mutual conductance—670 micromhos.
Plate current—1.8 milliamperes.

Usage: As a detector, high-frequency amplifier or low-frequency amplifier.

Outstanding features: Low plate-current consumption. Rigid spacing of the internal elements.

Maker: Supertron Mfg. Co., Inc.

An Efficient Rectifier of the Gaseous Type

Name of valve: Corona valve, Z-80.

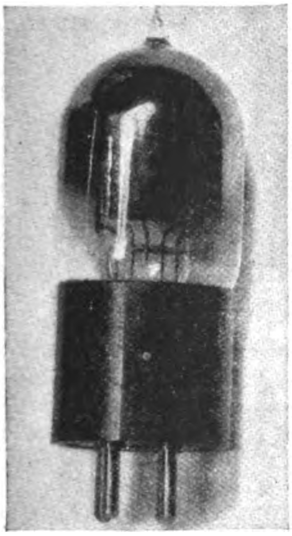
Description: This full-wave rectifier valve involves several new ideas in the method of localizing the useful gases that are used in the rectifying process. It is similar in size and appearance to the Raytheon valve and is interchangeable with any of the standard gaseous rectifiers now commonly used in "B" power-packs.

Valve rating:
150 volts at 100 milliamperes.
250 volts at 90 milliamperes (maximum).

Usage: As a rectifier for use in "B" power-packs which require output voltages up to approximately 250 and currents up to 90 milliamperes.

Outstanding features: Full-wave rectification. No filament. High-voltage output at normal current drain.

Maker: Schickerling Products Corp.



A Valve for Truphonic Amplifiers

Name of valve: DA-4 (Truphonic).

Description: This valve is somewhat smaller than the standard 201-a type, but is equipped with a standard UX-type base. It is a high-mu valve and it employs a 5-volt, ¼-ampere filament.

Valve rating:
Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—90.
Negative grid bias—0.

Valve characteristics (with plate voltage of 90 and no negative grid bias), as determined in the POPULAR RADIO TESTING LABORATORY:
Plate resistance—32,300 ohms.
Amplification factor—19.
Mutual conductance—590 micromhos.
Plate current—1.4 milliamperes.

Usage: Especially designed for use in the first and second stages of a "Truphonic" amplifier.

Outstanding features: High voltage amplification. Superior to the 201-a type valve when used in "Truphonic" amplifiers.

Maker: Donle-Bristol Corp.

A Tube for Standard Usage

Name of valve: Roy, type 201-a.

Description: This is a standard UX-201-a type of valve, with a UX-type base.

Valve rating:
Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—22.5 to 135.
Negative grid bias—0 to 4.5 volts.

Valve characteristics (with a plate voltage of 90 and a negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:
Plate resistance—13,700 ohms.
Amplification factor—9.7.
Mutual conductance—1,372 micromhos.
Plate current—2 milliamperes.

Usage: For any purpose for which a standard valve can be used.

Outstanding features: Standard all-purpose characteristics.

Maker: Tectron Radio Corp.

A Power Valve That Will Improve Reception

Name of valve: SX-171.

Description: This is a standard UX-171 type of valve with a UX-type base.

Valve rating:
Filament voltage—5.
Filament current—.5 ampere.
Plate voltage—90 to 180.
Negative grid bias—0 to 40.5 volts.

Valve characteristics (with a plate voltage of 180 and a negative grid bias of 40.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:
Plate resistance—2,040 ohms.
Amplification factor—2.77.
Mutual conductance—1,372 micromhos.
Plate current—20 milliamperes.

Usage: As an amplifier in the last low-frequency stage to avoid the distortion that results from overloading.

Outstanding features: Provides large volume without distortion from overloading. Contains a special reinforced support for the internal elements.

Maker: Schickerling Products Corp.

A Valve That Does the Work of Three

The next issue of POPULAR RADIO will contain an article by Manfred von Ardenne, the distinguished German radio expert who has just visited this country, telling of his experiments with Dr. Loewe on the new "multiplex" valves that can be made to serve the purpose of an entire amplifier.

Kadel & Herbert

A NEW KINK FOR

Keeping Your Log-Book

Practical pointers that will help the broadcast listener
to tune in on the station he wants—when he wants it.

By W. PENN LUKENS

DURING the past year or two an effort has been made to substitute the term frequency for wavelength, for use in identifying the places occupied by the various broadcasting stations. The effort has not been entirely successful. Apparently the term kilocycles frequency is a bit too technical for the lay mind.

The use of frequencies has undeniable advantages, and many call books and newspaper programs still list the frequency of each station as well as its wavelength. And the average fan is often forced to recognize that frequency has a meaning, for he may find that stations are fairly evenly allocated on the dial of his straight-line-frequency condenser, or that they are badly bunched on the lower portion of a straight-line-wavelength dial.

Recent acquisition of a superheterodyne receiver of remarkable range and selectivity, but with three-dial tuning, has forced the writer to log dial readings in some accurate and convenient form. Several tries at the usual methods of recording stations soon forced the conclusion that logging would have to be primarily by frequencies, in order to give even distribution of the stations; yet it was also desirable to keep sight of wavelengths. Therefore the chart (reproduced in part at the right) was developed and has proven ideal for every requirement. It is illustrated as applied to the particular three-dial superheterodyne, but may be equally well applied to any type of set with any number of dials.

The chart or log table may be made on ordinary cross-section paper, on which the divisions are marked off ten to the inch. Such paper may be obtained at most stationery stores.

Lines are drawn vertically, in ink, to give a number of columns. The first column shows kilocycles, and for the broadcast range should be from 1500 kilocycles down to 500 kilocycles. Each division of the cross-section paper represents five kilocycles.

The second column shows the wavelength in meters corresponding to the given frequency in kilocycles; the two columns together form what is known as a "conversion table." It is easy to find wavelength, roughly, by dividing 300,000 by the frequency in kilocycles. Thus for a frequency of 1000 the wavelength will be 300,000 ÷ 1000 = 300 meters. For a frequency of 1500 the wavelength will be 300,000 ÷ 1500 = 200 meters.

Of course the figure of 300,000 is only approximate. When making the chart it saves trouble and gives greater accuracy to take a call book which gives both wavelength and frequency—copying on the chart the wavelength in meters in its proper kilocycle place. Thus 1000 kilocycles is actually 299.8 meters, 1200 kilocycles is 249.9 meters, 620 kilocycles is 483.6 meters, etc.

It is possible to go through a call book and write down on the chart the location, call letters, wavelength and frequency of every station, but to do so would partly defeat the purpose of the chart. The best method is to go through the call book and note down the data for each of the stations that one usually gets. Thus in Chicago there will be a list of from 75 to 100 stations normally received, such as WOC, WLW, KDKA, WJZ, KMOX, and WSM.

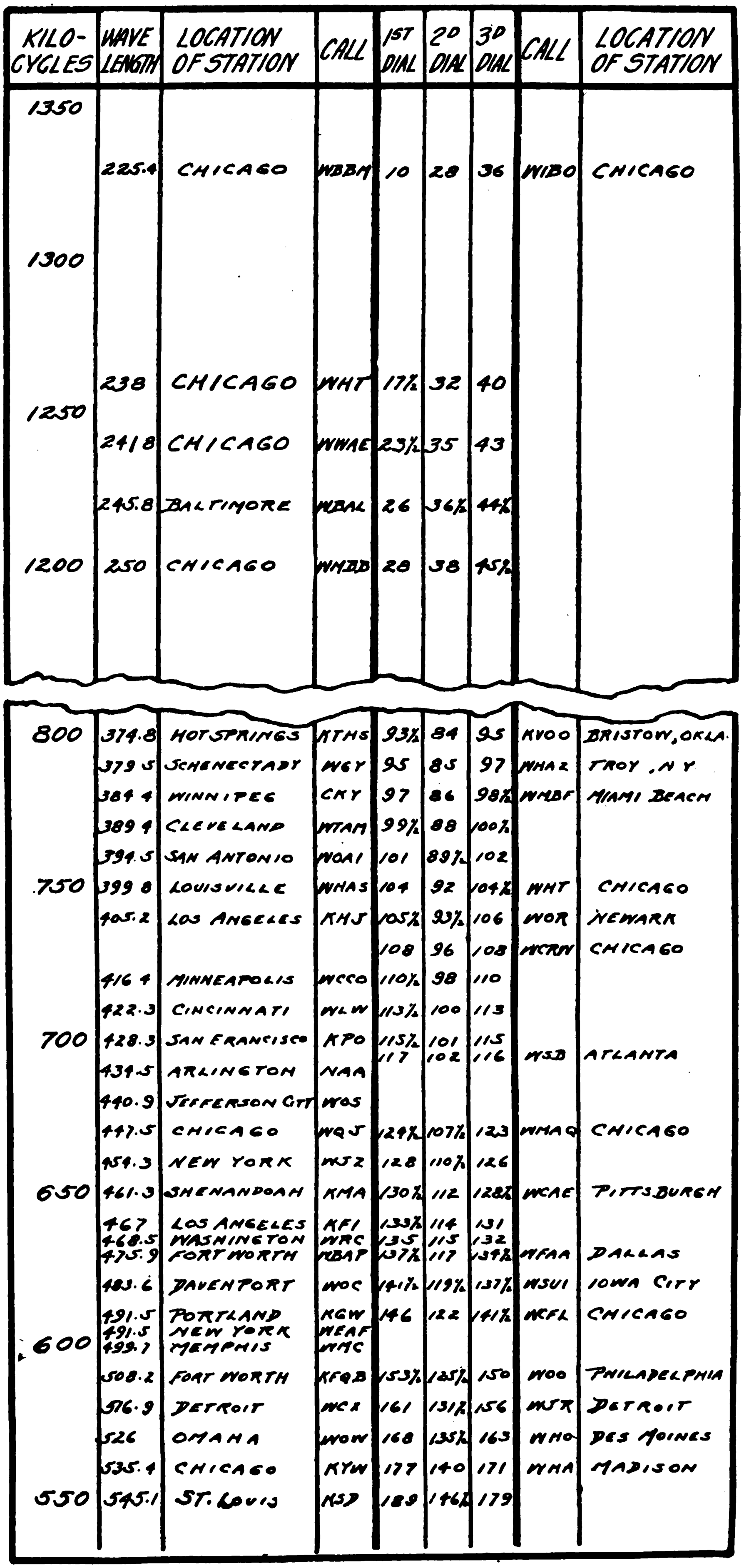
This listing may all be done at one time, saving time and promoting neatness. As these usual stations are actually tuned on the set, one need only to mark down the dial readings. When the operator tunes a station which is not pre-listed in this way, he must refer to the call book for its wavelength and frequency, in order to set it down in its proper place on the log chart.

It will be found that usually the stations are assigned a place every ten kilocycles. As the chart has a ruled space every five kilocycles, it is thus possible to list two stations for each frequency. But as there may be from two to twenty stations that have a given frequency, a second set of columns is added to the right of the dial readings, for listing the call letters and location of stations having duplicate frequencies, and hence duplicate dial readings. It is thus possible to list four or even six stations having the same frequency.

As the chart lists more and more stations, it becomes easy to forecast the exact dial readings which will bring in a desired but as yet unlisted station. The chart reads in an even sequence of decreasing frequencies and in a progressive sequence of increasing wavelengths. The dial readings will read in a similar sequence, as it is evenly spaced if the condensers are of the straight-line-frequency type, and similiar to the meters reading if they are of the straight-line wavelength type.

From this log chart it is easy to see the relationship between kilocycles and meters, showing why some condensers crowd the stations at the lower end; it is easy to see, also, why some sets seem less selective on the long wavelengths, for WOW, Omaha, and KYW, Chicago,

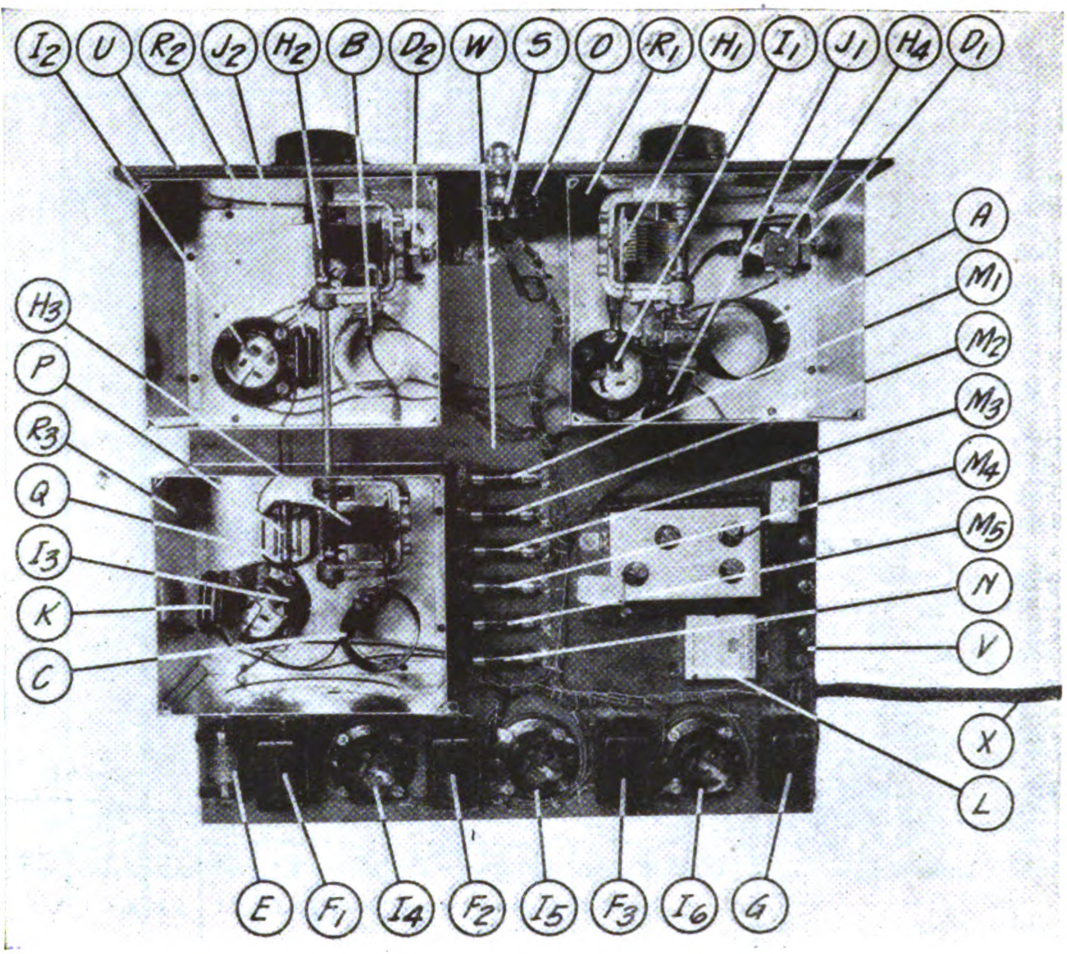
(*Continued on page 76*)



KILO-CYCLES	WAVE LENGTH	LOCATION OF STATION	CALL	1ST DIAL	2D DIAL	3D DIAL	CALL	LOCATION OF STATION
1350								
	225.4	CHICAGO	WBBM	10	28	36	WIBO	CHICAGO
1300								
	238	CHICAGO	WHT	17½	32	40		
1250								
	241 8	CHICAGO	WWAE	23½	35	43		
	245.8	BALTIMORE	WBAL	26	36½	44½		
1200	250	CHICAGO	WMBB	28	38	45½		
800	374.8	HOT SPRINGS	KTHS	93½	84	95	KVOO	BRISTOW, OKLA.
	379 5	SCHENECTADY	WGY	95	85	97	WHAZ	TROY, N Y
	384 4	WINNIPEG	CKY	97	86	98½	WMBF	MIAMI BEACH
	389 4	CLEVELAND	WTAM	99½	88	100½		
	394.5	SAN ANTONIO	WOAI	101	89½	102		
750	399 8	LOUISVILLE	WHAS	104	92	104½	WHT	CHICAGO
	405.2	LOS ANGELES	KHJ	105½	93½	106	WOR	NEWARK
				108	96	108	WCRW	CHICAGO
	416 4	MINNEAPOLIS	WCCO	110½	98	110		
	422.3	CINCINNATI	WLW	113½	100	113		
700	428.3	SAN FRANCISCO	KPO	115½	101	115		
				117	102	116	WSB	ATLANTA
	434.5	ARLINGTON	NAA					
	440.9	JEFFERSON CITY	WOS					
	447.5	CHICAGO	WQJ	124½	107½	123	WMAQ	CHICAGO
	454.3	NEW YORK	WJZ	128	110½	126		
650	461.3	SHENANDOAH	KMA	130½	112	128½	WCAE	PITTSBURGH
	467	LOS ANGELES	KFI	133½	114	131		
	468.5	WASHINGTON	WRC	135	115	132		
	475.9	FORT WORTH	WBAP	137½	117	134½	WFAA	DALLAS
	483.6	DAVENPORT	WOC	141½	119½	137½	WSUI	IOWA CITY
	491.5	PORTLAND	KGW	146	122	141½	WCFL	CHICAGO
	491.5	NEW YORK	WEAF					
600	499.7	MEMPHIS	WMC					
	508.2	FORT WORTH	KFQB	153½	125½	150	WOO	PHILADELPHIA
	516.9	DETROIT	WCX	161	131½	156	WJR	DETROIT
	526	OMAHA	WOW	168	135½	163	WHO	DES MOINES
	535.4	CHICAGO	KYW	177	140	171	WHA	MADISON
550	545.1	ST. LOUIS	KSD	189	146½	179		

THE "LOG CHART"

This record may be most easily kept on cross-section paper that may be obtained in any stationery store; the vertical and horizontal rules in tint (which are not shown in the accompanying illustration) help to keep the alignments.



A VIEW OF THE RECEIVER FROM ABOVE

FIGURE 1: *In this picture the tops of the shield "cans" are removed to show the layout of the instruments. The first high-frequency stage is shown at the upper right-hand corner; to the left is the second high-frequency stage, and below it is the detector stage. Note the cabled wiring.*

HOW TO BUILD

The Capacidyne Receiver

By HERBERT SNEAD

COST OF PARTS: *Not more than $79.00*

HERE IS A LIST OF PARTS NECESSARY FOR THE CONSTRUCTION OF THIS RECEIVER—

A—Hammarlund autocouple coil;
B and C—Hammarlund coils, type RF-17;
D1 and D2—Samson R. F. choke, No. 125;
E—Samson R. F. choke, No. 85;
F1, F2 and F3—Na-ald truphonic couplers, No. 301;
G—Na-ald truphonic output, No. 300;
H1, H2 and H3—Hammarlund midline condensers, .00035 mfd.;
H4 and H5—Hammarlund balancing condensers;
I1, I2, I3, I4, I5 and I6—Na-ald sockets, type 400;
J1 and J2—Sangamo fixed condensers, .006 mfd.;
K—Sangamo fixed condenser, .001 mfd.;
L—Sangamo fixed condenser, series "A," 1 mfd.;
M1, M2, M3, M4 and M5—Amperites, No. 1A;
N—Amperite, No. 112;
O—Carter Hi Ohm variable resistance, 0 to 500,000 ohms;
P—Sangamo fixed condenser, .00025 mfd., equipped with grid-leak mounts;
Q—Polygrid fixed resistor, 3 megohms;
R1, R2 and R3—Hammarlund stage shields;
S—Carter "Imp" pilot switch;
T1, T2, T3 and T4—Eby binding posts, marked "Ant.," "Gnd.," "Speaker +" and "Speaker —," respectively;
U—Composition panel, 7 by 18 by 3/16 inch;
V—Composition binding-post strip, ¾ by 5¾ by ⅛ inch;
W—Baseboard, 17 by 17 by ½ inch;
X—Battery cable, 6 leads.
Bus wire, spaghetti, etc.

THE golfer gets his big thrill from a perfect drive, flying far and straight down the fairway. The fisherman gets his from the struggles of the game fish, securely hooked. The radio constructor's moment occurs when the first strains of music issue from his loudspeaker after his painstaking construction of a new circuit.

The Capacidyne offers a field of experiment in a new direction in high-frequency amplification. Capacitative coupling with tuned-impedance amplification is the keynote of this new receiver. Truphonic amplification is incorporated in the low-frequency stages with excellent reproduction, both in quality and volume, as a feature.

The list of parts given on page 54 includes the exact instruments used in the laboratory model of this receiver. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

It has been truly said that radio has made more "prevaricators" than golfing and fishing combined. With this statement in mind, claims bordering on the improbable have purposely been avoided in presenting this receiver. Every circuit has its advantages and its drawbacks. Suffice it to say that here is presented a circuit which offers sufficient selectivity for practical use without loss of quality due to cutting off sidebands, which provides sufficient voltage amplification for good volume and distance getting ability, which gives (within the scope of a moderate amount of money and a reasonably simple type of equipment) excellent reproduction—and which is simple to build and especially easy to operate.

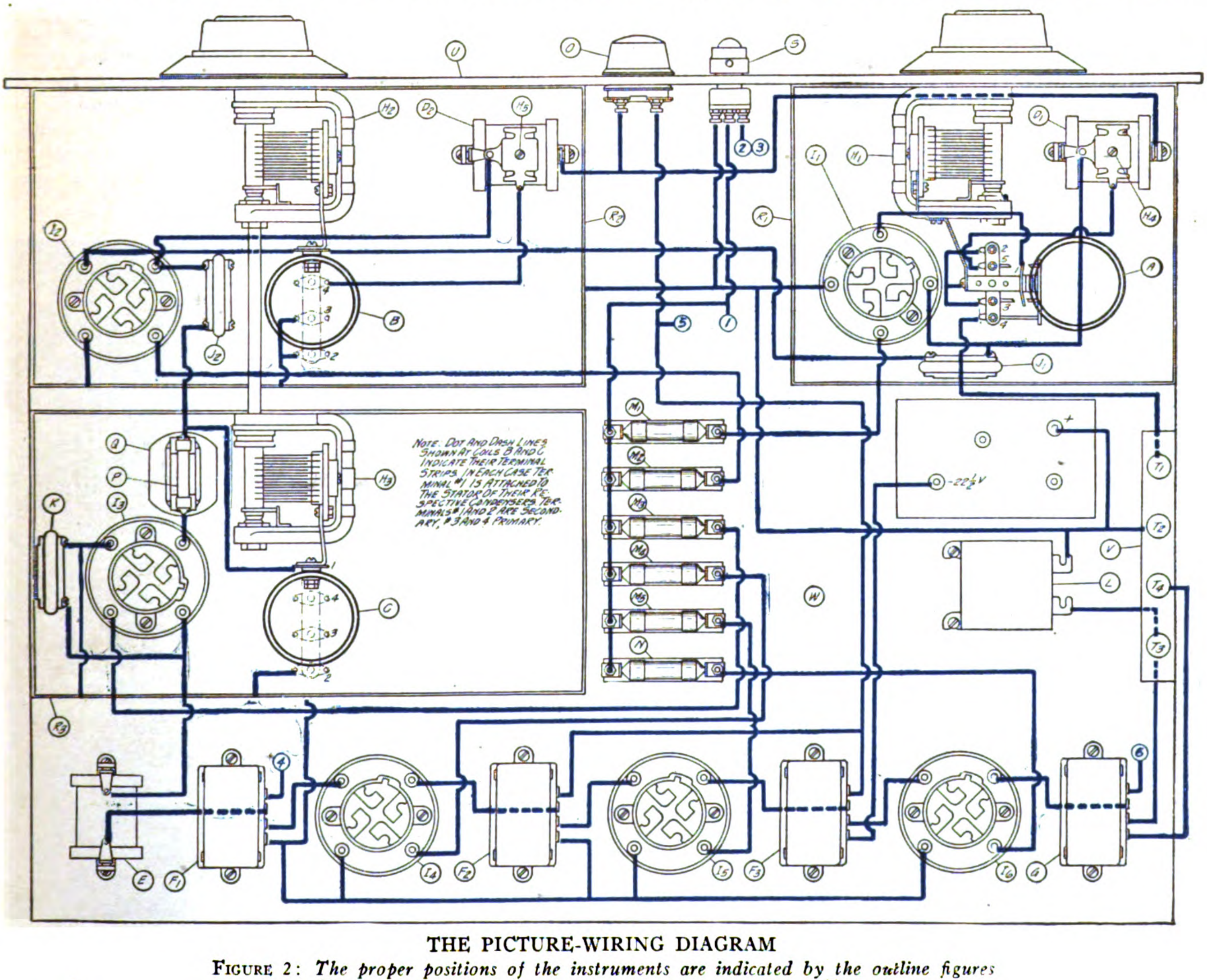
The input amplifier comprises two stages of high-frequency amplification. To prevent coupling through the "B" battery or "B" power-pack, if one is used, high-frequency chokes are placed in the "B" supply leads.

As the present-day popularity of stage shields is well founded in scientific principles, complete stage shields or "cans" for the two high-frequency amplifier valves and for the detector valve are incorporated. To simplify tuning, the second high-frequency stage condenser and the detector stage condenser are operated by a common shaft. Neutralization or other balancing means has usually meant a compromise between sensitivity and freedom from oscillation. For this reason a so-called automatic means of balancing has been avoided, and a control of sensitivity, serving simultaneously as a volume control, has been included in the form of a variable high resistance in the plate circuit of the high-frequency valves.

Maximum selectivity in antenna tuning is acquired by automatic variation of primary coupling. Some regeneration is introduced into the antenna circuit and into the second high-frequency circuit by means of the small balancing condenser connected according to the "Rice" method.

Detector regeneration has purposely been avoided, and the loss of sensitivity resulting from its omission is amply compensated for by the avoidance of the distortion and instability that it introduces.

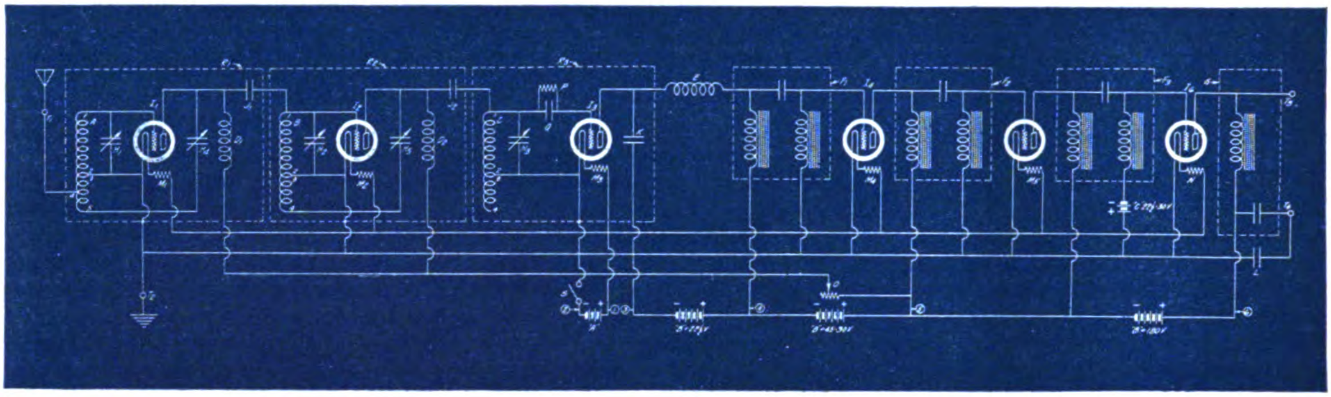
Filament control is automatic; it is considered superfluous to furnish manual



NOTE: DOT AND DASH LINES SHOWN AT COILS B AND C INDICATE THEIR TERMINAL STRIPS. IN EACH CASE TERMINAL #1 IS ATTACHED TO THE STATOR OF THEIR RESPECTIVE CONDENSERS. TERMINALS #1 AND 2 ARE SECONDARY, #3 AND 4 PRIMARY.

THE PICTURE-WIRING DIAGRAM

FIGURE 2: *The proper positions of the instruments are indicated by the outline figures in* BLACK. *The* BLUE *lines indicate the complete wiring scheme. The* BLUE *numbers correspond with the numbered battery leads of Figure 6, and show the proper cable connections to be made to the "A" and "B" batteries.*



THE SCHEMATIC WIRING DIAGRAM

FIGURE 3: *A certain amount of regeneration is obtained in the two high-frequency stages, shown at the left of the diagram. The regeneration is controlled by means of the balancing condensers, H4 and H5.*

filament control for any of the valves in a circuit of this type which is essentially non-regenerative.

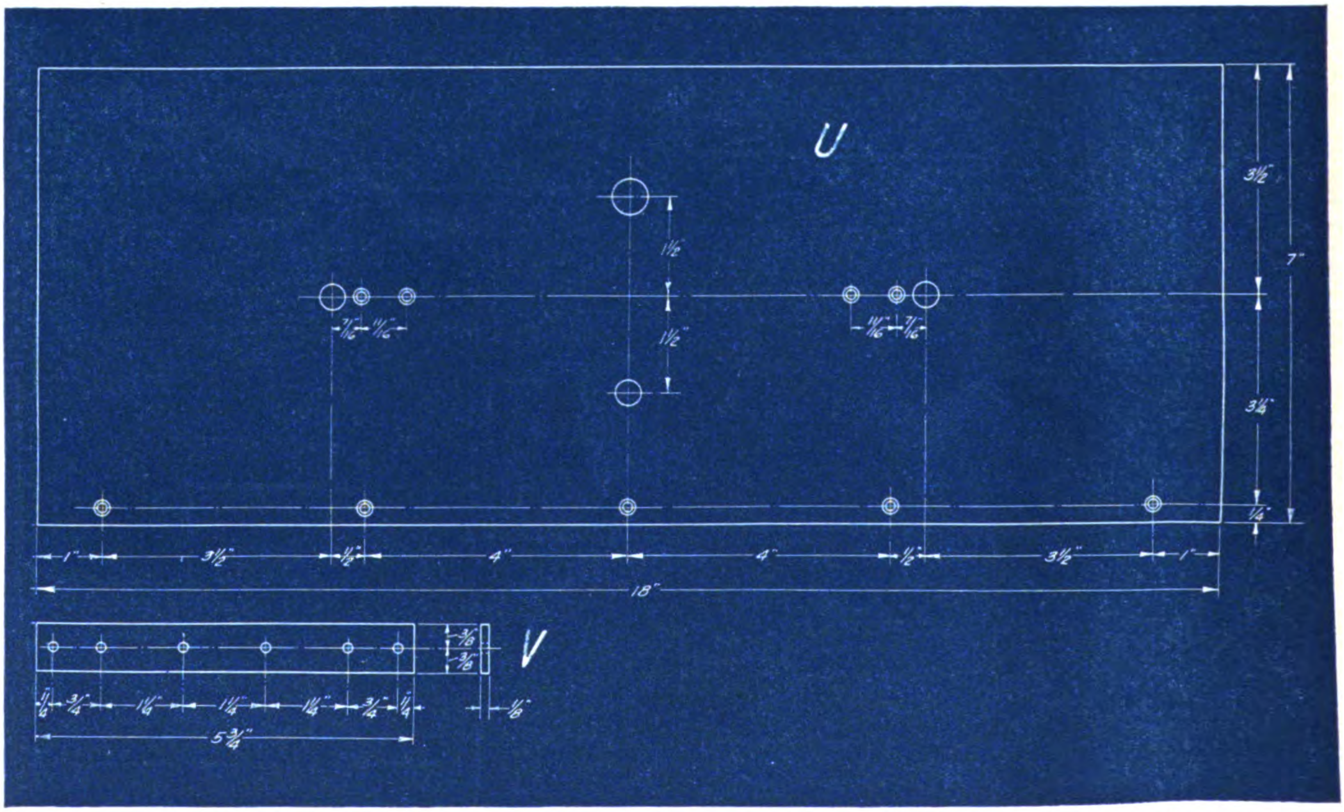
The low-frequency amplifier carries out the same general coupling scheme used in the high-frequency end.

The Donle magnetically coupled impedances (Truphonic) for both plate and grid, with capacitative stage coupling, are employed. Though such an amplifier requires three vacuum valves to be in excess, as to volume, to a two-stage transformer-coupled amplifier, the quality of reproduction delivered is well worth the extra valve. To permit the use of the new semi-power output valves, carrying moderately high plate voltages, and to prevent this direct current from burning out the speaker windings, an output device is also incorporated. The foregoing briefly describes the general characteristics of the receiver.

How to Construct the Set

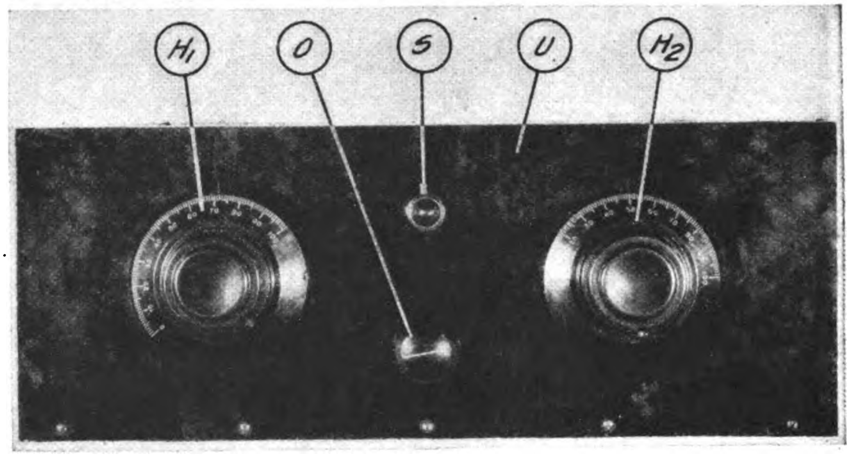
Of course we must commence with parts list, wiring diagrams and drawings. The parts given in the list at the head of this article are, in the author's opinion, the best to use for the specific purpose intended. Substitution of other makes of high-grade parts is not to be discouraged, however, provided the constructor knows the essentials of receiver design.

Figure 4 shows the drilling layout of the panel used on the set herein illustrated. The binding post drilling layout is also shown in Figure 4. Inasmuch as this description is that of one experimenter telling how to duplicate his own favorite set, and not directions for assembling a kit produced by manufacturers, a small deviation from panel and baseboard sizes, and also in the arrangement of parts, is quite in order.



THE PANEL LAYOUT OF THE CAPACIDYNE

FIGURE 4: *The exact drilling specifications of the front panel are indicated at U. In the lower left-hand corner, at V, is the drilling layout for the binding-post strip.*



A FRONT VIEW OF THE CAPACIDYNE PANEL

FIGURE 5: *The two large dials are the tuning controls; between them, at O, is the volume control knob. At S is the combination battery switch and pilot light.*

The schematic wiring diagram is shown in Figure 3 and the picture diagram in Figure 2. These need no particular explanation.

Having collected all of the necessary materials and parts, actual construction may be commenced. The first step is to drill the panel. The easiest method of drilling is to draw a template full size on heavy drafting paper and then cut out the template so that the edge of the paper corresponds to the edge of the panel. Then clamp the completed paper template to the panel and punch and drill right through the paper.

The layout drawing of the baseboard, giving exact locations and dimensions of the various parts, is purposely omitted, as there are no precautions that need be observed except the general one of so locating all equipment that all high-frequency leads are kept as short and direct as possible. Each shield contains within it all of the equipment pertaining thereto, including the fixed condenser that couples it to the following stage.

By placing the detector stage directly behind the second high-frequency stage, the two tuning condensers may be operated by means of a common shaft. The shaft is of ¼-inch brass rod. The condensers lend themselves extremely well to this purpose, as their shafts may be removed by loosening the small set screws in the rotor sleeve, and the brass rod, of proper length, may be inserted. All of the equipment is to be screwed to the baseboard by means of round-head, brass wood-screws, and the panel may also be fastened in this manner.

A mounting to support the auto-couple coil is supplied with it by the manufacturer, which permits the turning of the condenser to change the coupling between the primary and the secondary. The primary is a split winding, the mid-tap serving as the antenna connection, the inside end-tap serving for ground and the other tap serving for the feed-back connection. The other coils are not supplied with mounting brackets. These, however, can readily be made out of ½-inch brass strip or 1-inch by 1-inch brass angles, ½-inch wide, obtainable in any hardware store.

The primary winding of the detector coil is not used and is left unconnected. The primary of the second high-frequency coil is utilized for regeneration. The tap provided for neutralization is cut off close to the coil. The entire coil is fastened to the condenser stator connection by means of the bracket mentioned above.

In mounting instruments inside of the shields, make sure that none of their terminals are in contact with the shields.

How to Wire the Set

Wiring should be done in a strictly speaking "electrical" manner. It should follow the diagram given in Figure 2. Flexible, insulated wire should be used, and all leads, except grid and plate leads, should be cabled and tied together with string. Wiring is facilitated if only the front and base of the shields are screwed fast, the sides, rear and top being fastened after the wiring is completed. Holes must, of course, be drilled through the shields for the passage of the connecting wires.

It will be noted that no jack is provided for the reproducer. Binding posts are preferred by the author. It is also desirable to incorporate a battery cable into the set wiring, as this makes short circuiting of the batteries less probable.

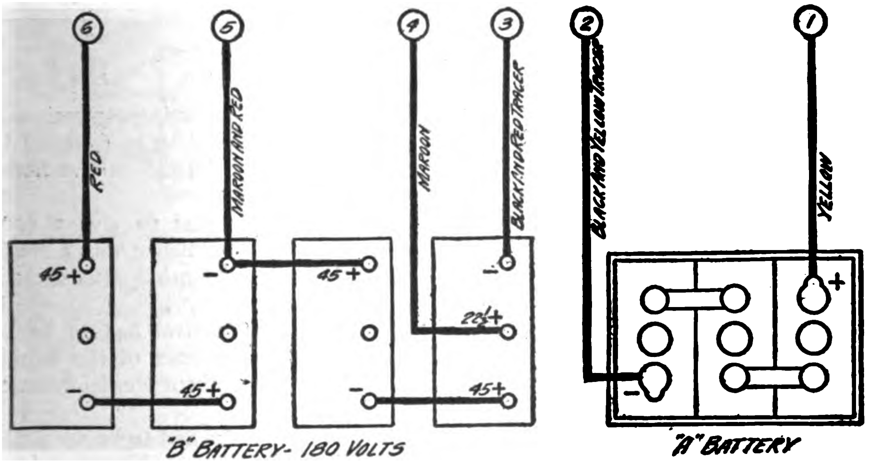
How to Operate the Receiver

The builder should experiment with plate and biasing voltages for the high-frequency and detector valves. It will usually be found that with 4½ volts negative bias on the grid, 90 volts "B" battery potential will usually give best results for the high-frequency valves. If a UX-200-a detector valve is used 22½ volts will be sufficient. With a UX-201-a detector valve and 4½ volts bias, 45 volts will operate well.

The station settings correspond closely on the two dials, so that the user can take one in each hand and rotate them slowly to find the wanted stations. Volume is adjusted by means of the variable resistance.

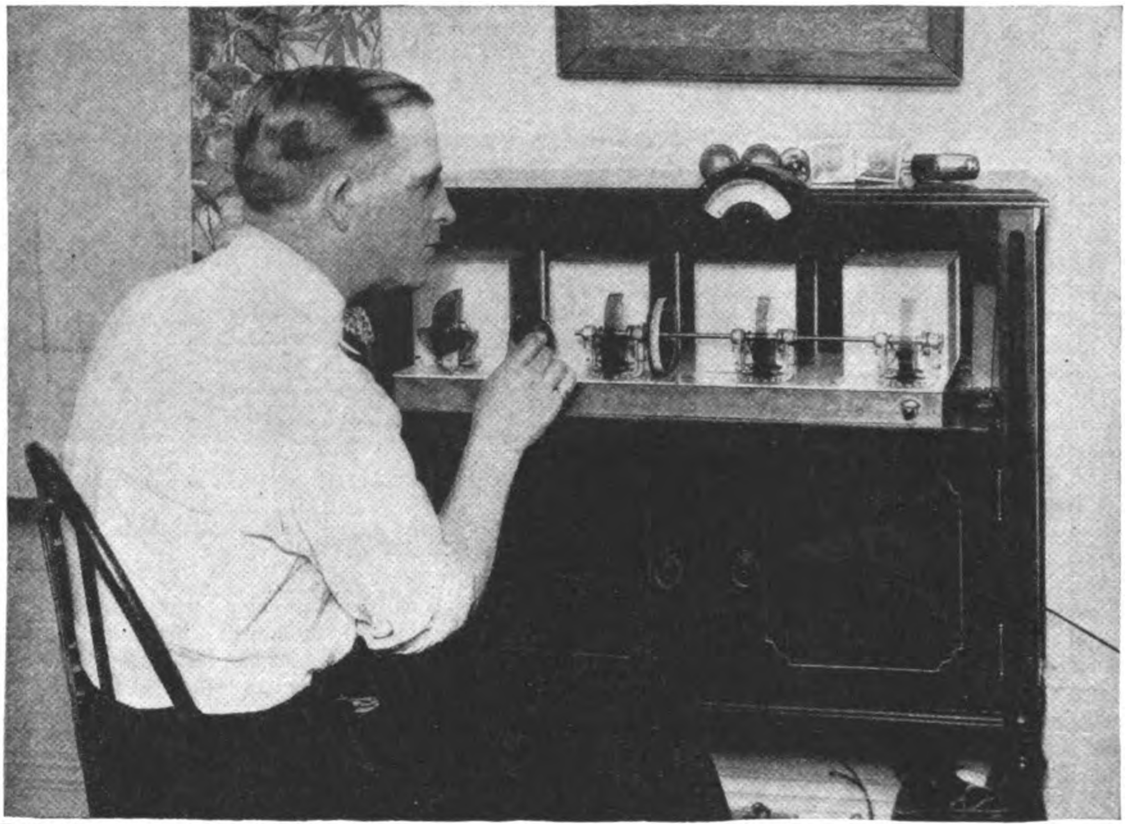
It will be found that, contrary to usual practise, the antenna dial is the sharp setting dial, and the other dial is fairly broad. Of course, they tune absolutely independent of each other, the settings of one having practically no influence upon the settings of the other.

The writer has had exceptionally good success with this receiver and believes it will be of more than general interest to the experimenter as well as the fan.



THE BATTERY HOOK-UP FOR THE RECEIVER

FIGURE 6: *The numbered leads correspond with the* BLUE *numbers in Figure 2. Binding posts are not used for the battery leads; the leads shown above should be connected directly with the wiring of the receiver. The "C" battery is housed within the receiver.*



From a photograph made for POPULAR RADIO

AN EXPERIMENTAL MODEL OF THE NEW LC-28

When the preliminary development work on the new receiver had been completed, the constructional details were worked out progressively in the POPULAR RADIO LABORATORY, *until simplicity in construction and wiring with highest efficiency in operation were finally achieved.*

THE COMING OF THE NEW

LC-28 RECEIVER

With this issue, POPULAR RADIO makes this preliminary announcement of its latest and best contribution to the radio art—the remarkable new LC-28 receiver. Next month's issue—for September—will contain detailed information concerning the specific design of this receiver. And in the October number will appear the full constructional details.

ONCE more is POPULAR RADIO making a real and substantial contribution to the radio art.

The POPULAR RADIO LABORATORY—which contributed the popular Cockaday Four-Circuit Tuner in May, 1923, the Improved Four-Circuit Tuner in January, 1924, the Four-Circuit Tuner with Resistance-Coupled Amplifier in October, 1924, the LC-26 in December, 1925, and the LC-27 Receiver last year—has been engaged for many months in the development of a receiver that has been declared by unbiased experts to represent a definite advance in the field of radio reception.

It will be designated as the LC-28.

Ever since the introduction of the LC-27, the Technical Staff of POPULAR RADIO have been making tests and proving certain new principles and theories in radio reception. These new theories are incorporated in the LC-28 circuit.

Next month's issue—for September—will contain detailed information concerning the specific design that has been finally adopted. And in the October issue will appear the complete constructional details.

The new LC-28 receiver marks an advance over the LC-27 receiver in several important respects. For instance:

When the LC-27 receiver was developed, the "Fourteen Points" of design were listed as follows:

1. The quality of reproduction had to be as high as radio science permitted;
2. The cabinet had to be designed to harmonize with the representative home of good taste;
3. The receiver had to give a consistently good performance with a minimum of care and attention, after the set was once installed;
4. The tuning control had to be so simple that any member of the family could operate it without special instruction;
5. The selectivity had to be adequate to eliminate interference from stations on adjoining wavelengths;
6. The set had to operate on any type of outdoor antenna, a loop antenna or on no antenna at all;

7. The set had to operate on house current or batteries, as desired;

8. The parts had to be shielded adequately;

9. The power amplifier and output filter had to supply ample volume without distortion;

10. The construction had to provide for the use of nationally known valves and parts that are easily obtainable in any locality;

11. The set had to be non-regenerative in order to prevent radiation;

12. The receiver had to be of simple construction, with the minimum of adjustments, controls and balances;

13. The set had to have a sensitivity adequate to provide good reception of distant programs;

14. The set had to be fool-proof in construction.

In the development of the LC-28 receiver these fourteen points were carefully considered, not only because each point had to be covered, but covered in a manner that took into consideration the relative worth of each one of these features.

Point 1, for instance—the quality of reproduction had to be as near perfect as possible;

Points 2 and 3 are as important in the LC-28 as in the LC-27;

Point 4 was considered so essential in the new model that a special new drum dial has been incorporated that simplifies and beautifies the receiver more than any other single item;

Point 5; the selectivity of the LC-28 has been increased without injuring the quality of reproduction;

Points 6 and 7 have been given the same importance in the LC-28 as in the LC-27;

Point 8; a unique design of shielding has been developed for the LC-28 that is adequate for increased amplification;

Points 9, 10, 11 and 12 are likewise important features; more especially so is No. 12. It is believed that the LC-28 is the simplest set to build that has ever been described in a radio publication.

Point 13; the sensitivity has been stepped up manifold without sacrificing the qualities called for in Point 12;

Point 14; the set is "fool-proof" not only in construction, but in installation and operation.

The Technical Staff of POPULAR RADIO believes that radio sets in the future will be built into *two units* or compartments; one of them will be the high-frequency end (including the detector); this may be called the "high-frequency pack."

The high-frequency pack of the LC-28 consists of three stages of tuned high-frequency amplification and a vacuum-valve detector. This is complete in a single shielded unit.

A second unit (including the low-frequency end) consists of two or three stages of low-frequency amplification; this might be called the "low-frequency pack."

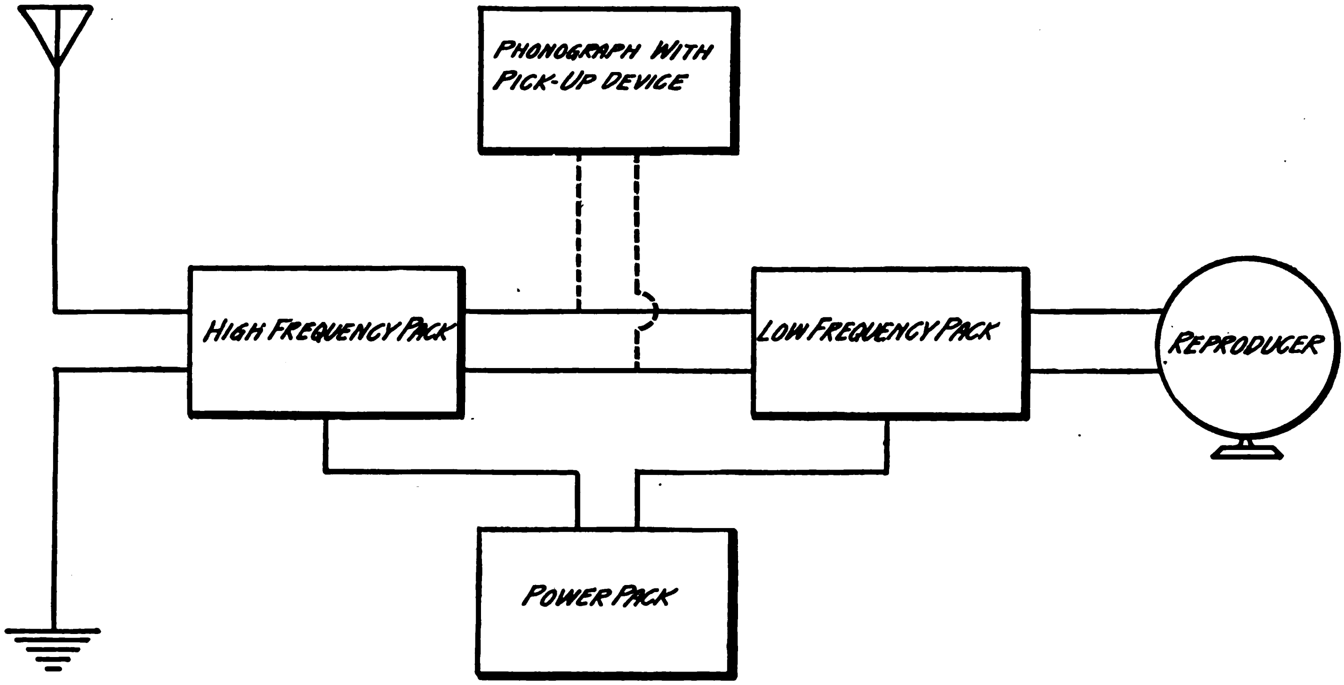
The kind of currents flowing in either of these units should be shielded from the currents flowing in the other and the two packs should be specifically *designed for their distinctive functions.*

A graphic layout of a complete unit set up is shown in Figure 1. This includes a phonograph pick-up which may be switched "on" in place of the high-frequency pack when it is desired to use the low-frequency pack and reproducer for the production of recorded programs.

The constructional article that will appear in October, therefore, will be concerned only with the "high-frequency pack," although the proper methods for using it with various types of manufactured low-frequency amplifiers will be shown, as well as how to build the various types and how to connect them properly in the circuit.

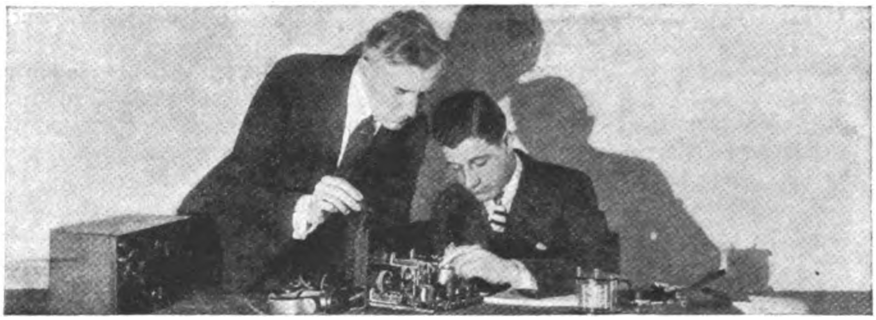
At the beginning of this article is shown one of the early laboratory models of the receiver; it was designed to be used with any type of outdoor antenna, with a loop antenna, or without any antenna at all.

The September issue will contain further advance information that will be of interest and value to the experimenter and to the engineer alike—as well as to everyone who is interested in the betterment of broadcast reception.



THE FUNDAMENTAL SCHEME FOR THE NEW LC-28

FIGURE 1: *This schematic layout shows the general electrical design of the new LC-28. It comprises a broadcast pick-up (high-frequency pack with amplifier and detector stages), an electrical pick-up for phonograph programs, a low-frequency amplifier, a source of power ("ABC" power-pack) and a reproducer.*



WITH THE EXPERIMENTERS

Conducted by S. Gordon Taylor

A Handy Set-Up for Testing Out New Circuits

I have been experimenting with various hook-ups for several years, and it has always been a matter of trouble or expense to provide each new detector circuit with an amplifier. Either I had to rebuild the old amplifier into the new circuit, or else I had to buy new parts for the amplifier in the new circuit.

I finally hit upon a scheme which permitted me to use one standard receiver so arranged that I could try out new detector circuits with the old amplifier without the necessity for dismantling the old detector circuit. And in testing the new detector circuits I could compare them with the old by an instantaneous change-over arrangement of switches.

The set-up I used is shown in Figure 1. My standard receiver, consisting of a Haynes tuner and a two-stage amplifier, is shown at the right. At the left is the new detector circuit with which I am experimenting at the present time. It is a short-wave tuner capable of bringing in the stations that broadcast on the wavelengths around and below 100 meters.

A study of the circuit will show that when the three switches, A, B and C, are thrown to the left, the antenna, the amplifier and the "A" battery are connected to the new detector. When thrown to the right, the new detector circuit is cut out entirely and the standard detector hook-up is placed in circuit.

This particular combination of detector tuning units is an excellent one because it permits the receiver to cover the entire amateur and broadcast wavebands from 40 meters up to 550 meters. When it is desired to tune in stations below 200 meters the short-wave tuner is brought into play. To go back up to the regular broadcasting waveband requires only an instant to throw the switches, thus putting the standard tuner into operation.

—James H. Knapp, *Philmont, N. Y.*

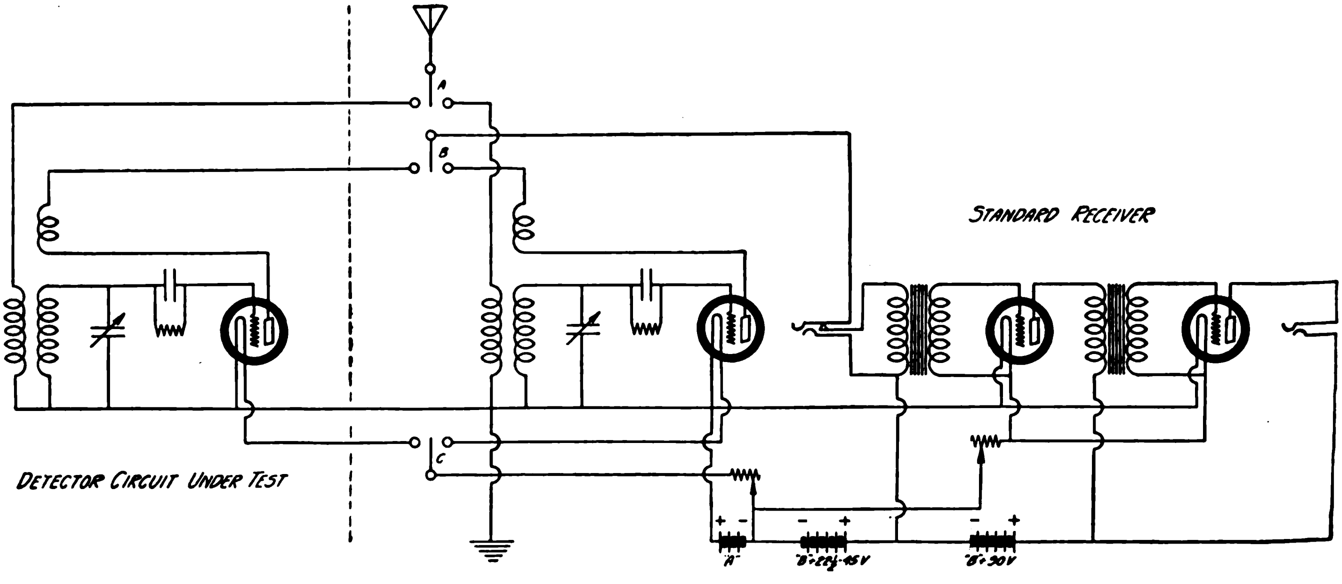
How I Even Up the Wear on My "B" Batteries

The tapping of the usual "B" battery block for the detector plate voltage and for the high-frequency amplifier plate voltages represents one of the greatest economic wastes in present-day radio. When a section of a "B" battery is given extra work to do (as in the case of an intermediate voltage tap), that section wears out first, spoiling the battery as a unit. And even so, it is seldom that the precise plate voltage required for best results can be obtained from the fixed taps of a "B" battery.

A simple and economical solution of the necessary plate voltages is to employ a variable resistor, with sufficient resistance range, connected in the lead going to the positive terminal of the entire "B" battery. One variable resistor should be employed for the detector valve and another for the high-frequency amplifier valves and additional individual resistors for any other required voltages, such as for the first low-frequency valve. A suitable resistor, shunted by a .01 microfarad condenser, so as to bypass the high-frequency currents around the variable resistance, should be incorporated in the circuit.

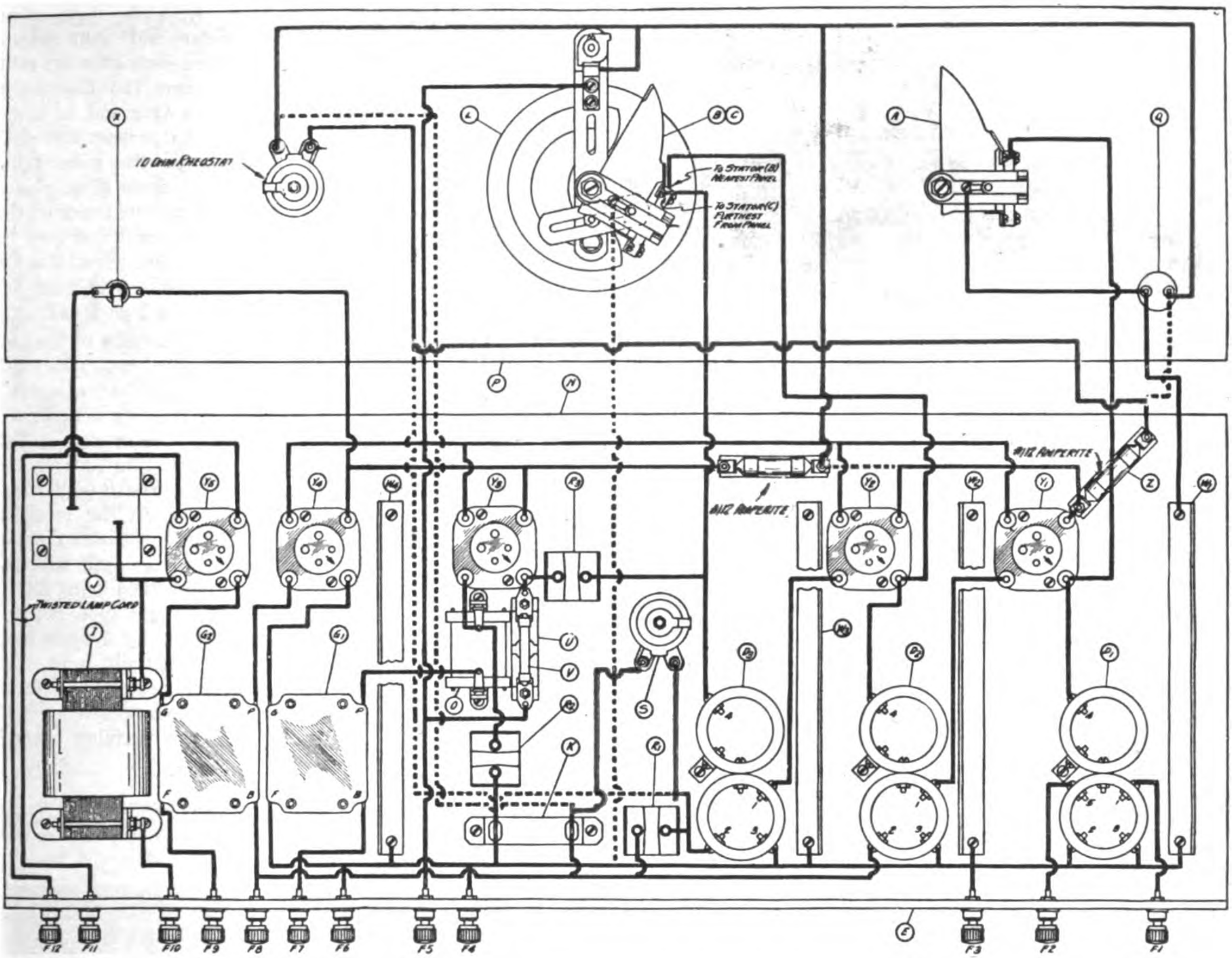
This arrangement permits of operating the detector valve and the high-frequency valves at their most critical point as regards plate potential. Meanwhile, the drain for intermediate plate voltages is placed on the entire "B" battery ensuring a longer useful life and also the absence of such noises as might arise through run-down and therefore defective cells. The efficiency of the receiver will be greatly increased.

—Chas. Golenpaul



A SIMPLE RECEIVER AND TEST SET-UP

Figure 1: *A simple three-valve receiver arranged with switches to facilitate trying out different detector circuits without dismantling the set.*



AN IMPROVED VOLUME CONTROL FOR THE LC-27 RECEIVER

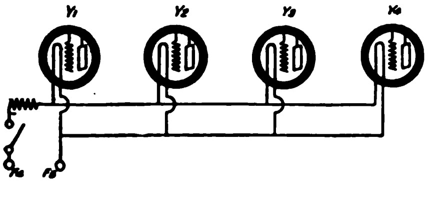
FIGURE 2: *This is the revised wiring diagram; the wires to be removed are indicated by the dotted lines; the* BLUE *lines indicate the new connections. A 10-ohm rheostat is installed on the panel in place of the old variable resistance, which is remounted on the baseboard; another amperite is also installed as shown. This scheme also provides automatic control of the pilot light.*

Hints on the LC-27 Receiver

Improving the Volume Control

UNDER certain local conditions it has been found that the volume control incorporated in the LC-27 receiver is not always capable of cutting down the volume sufficiently. This is especially true where it is necessary to keep reproduction toned down to little more than a whisper.

An excellent volume control may be obtained by the use of a filament rheostat to control the filament voltage of the two high-frequency amplifier valves. With this control the volume can be smoothly varied from zero to maximum.



THE OLD FILAMENT CONTROL ARRANGEMENT

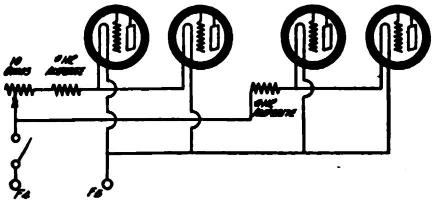
FIGURE 3: *The first four valves of the LC-27, with their filaments regulated by a single amperite. The scheme of revision is shown in Figures 2 and 4.*

Figure 3 shows the schematic diagram of the present arrangement of the two high-frequency valves, detector and first low-frequency valves. The filament of these four vacuum valves are connected in parallel and controlled by a No. 1 automatic filament control.

Figures 2 and 4 show the filament connections with the proposed volume control installed. The 10,000 ohm resistance, which is the present volume control, should be removed from the panel and remounted on the baseboard in the rear of the receiver, adjacent to coil D-3 and the fixed condenser R-1. A 1½-inch brass angle with a ⅜-inch hole for the shaft will serve very nicely as a mounting for this variable resistance. Once this unit has been adjusted for best operation it may be left alone.

The 10-ohm rheostat should be mounted on the panel in the place formerly occupied by the 10,000 ohm resistance. Connect one side of this rheostat to the receiver side of the battery switch and the other side to a No. 112 amperite, which in turn is to be connected to the negative filament of the two high-frequency valves.

(*Continued on page 71*)



THE FILAMENT CONTROL REVISED TO CONTROL VOLUME

FIGURE 4: *In this revised circuit, the 10-ohm rheostat regulates the filament current to the two high-frequency amplifier valves and thus controls the volume.*

IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

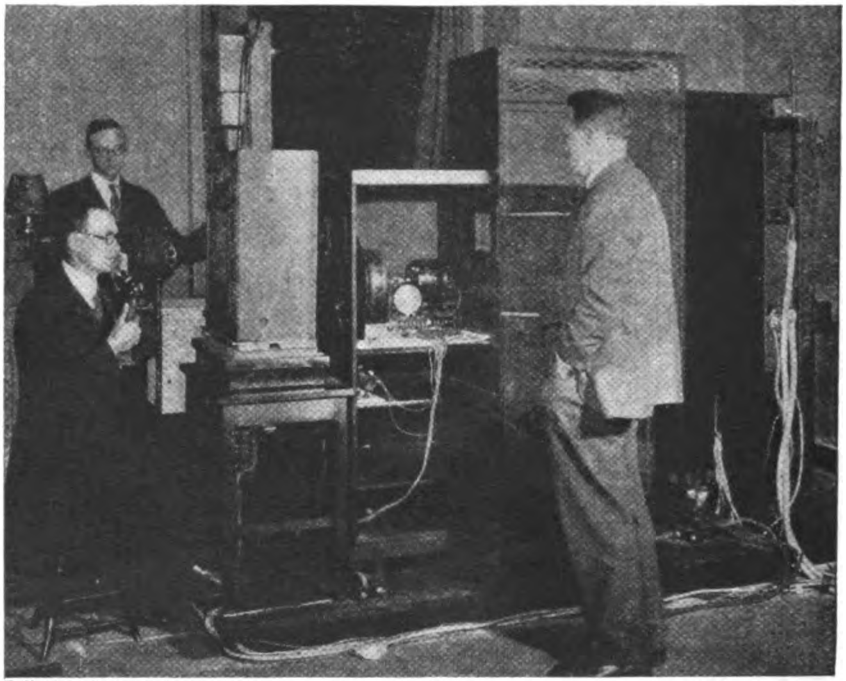
How the New Television Works

THE American Telephone and Telegraph Company's new process of television, developed largely by Dr. Herbert E. Ives and Dr. Frank Gray, of the Bell Telephone Laboratories, was mentioned in the preceding issue of POPULAR RADIO and has been so much discussed in newspapers and other publications printed more rapidly than this Department can be that there is no necessity to describe it in detail.* The scene to be transmitted is split up automatically, into a large number of separate units, each corresponding to a small section of the scene, like the cut-up blocks of a picture puzzle. These are then sent, in succession, over the wire or over the radio link, are put back together into the proper arrangement side by side, and the scene is thus reconstructed. The novelties of the new process are chiefly in the means perfected for doing this with the extreme rapidity which is necessary.

There are three important devices by which this speed is attained. The first is the method of viewing the object to be transmitted. Instead of illuminating the face of the sitter with a very intense light, as has been previously the custom of television experimenters, Dr. Frank Gray devised a plan of moving back and forth over the face of the sitter a small spot of intense light. Thus only one tiny unit of the face is illuminated at once. The amount of light reflected from this illuminated spot, more light or less depending upon the whiteness or blackness of that spot, constitutes the signal to be transmuted into electricity and sent over the wire or by radio. The motion of the light spot is controlled by a rotating disk, slotted spirally, so that the light ray describes a repeated back-and-forth path.

The second important innovation is the huge type of photoelectric cell used to transmute the reflected light into an electric signal. This is the personal invention of Dr. Ives, who was also in general charge of the project. These cells are glass cylinders about three inches in diameter and some fifteen inches long. Three such cells are used to receive light from the illuminated spot on the sitter's face and to transmute this in the usual manner into electricity.† Because of the great light-collecting power of these giant photoelectric cells the illuminated spot on the sitter's face may be small and may be passed over quickly, thus permitting the transmission of a picture with much detail without preventing high speed.

The third essential novelty of the new process is the ingenious means of exact synchronization between the transmitting apparatus and the receiver. Transmission is controlled by the moving spot of light, which is regulated, in turn, by the rotation of the slotted disk through which the light ray shines. At the receiving end, the electric signal sent over the wire and corresponding in strength with the whiteness of the point then being illuminated by the moving light spot, is transmuted back into light by a neon lamp in a manner not essentially new. The electric glow in the neon gas varies in intensity in strict correspondence with the strength of the arriving electric signal.



Bell Telephone Laboratories

THE NEW "ELECTRIC EYE" OF THE TELEPHONE

Mr. R. C. Mathes, of the Bell Telephone Laboratories, seated at the left holding the telephone instrument, is in position to be seen by television; the moving spot of light comes from an arc lamp in the box at the extreme right and is directed back and forth across his face by the revolving disk in the open box at the center. On the top and two sides of the smaller box which Mr. Mathes faces are three of the large photoelectric cells which transmute the light signal into an electric signal, for transmission by wire or by radio.

---

* The process was demonstrated, on April 7, 1927, at the Bell Telephone Laboratories, in New York City, to representatives of the press and to invited guests. Mr. Herbert Hoover, at the Washington end of a telephone wire, talked with Mr. Walter S. Gifford, president of the American Telephone & Telegraph Company, in New York, and was simultaneously visible to Mr. Gifford and to the New York audience. Thereafter, similar television transmission was demonstrated from the experimental radio station of the telephone company at Whippany, New Jersey. Technical details of the process are described in a pamphlet entitled, "Television, an Achievement in Electrical Communication," distributed to the guests on the occasion of this demonstration. Other technical details were discussed by Dr. Herbert E. Ives and Dr. Frank B. Jewett before the meeting of the National Academy of Sciences, in Washington, during the week of April 25, 1927. Popular descriptions of the process have been published in many newspapers and magazines; for example, in the *American Review of Reviews* (New York City) for May, 1927, pages 516-518.

† On the properties of photoelectric cells, see: "Radio's Newest Instrument, the Photoelectric Cell," POPULAR RADIO for November, 1925, pages 397-404.

To make this glow of the neon lamp reproduce the exact scene visible at the transmitter, the neon lamp must not be seen as a whole, but must be viewed one small unit at a time, each such unit corresponding to the point of the sitter's face illuminated at the corresponding instant by the moving light spot. To arrange this, the telephone engineers use a "viewing disk," slotted in precisely the same manner as is the disk which moves the light ray of the transmitter. This viewing disk allows the eye of the viewer at the receiver to see the neon lamp from point to point in succession, just as the moving light spot "sees" the face of the sitter.

Exact synchronism of these two disks is obviously a prime necessity. In the operation demonstrated between Washington and New York, the face of Mr. Hoover was divided by the moving light spot into 2,500 separate units. The entire face was covered by this light spot eighteen times a second, making 45,000 separate impulses which had to be sent and received each second. A defect of synchronism by more than one-half of the width of one position of the light spot would ruin the transmission. Accordingly the two disks, one in Washington and the other in New York, had to operate at the same speed with a variation of less than one ninety-thousandth of a second. This was done by using two sets of synchronous motors, driven by a master oscillator at one end of the line. Two control channels were used, one for coarse adjustment, the other for fine adjustment and to prevent "hunting."

The appearance of the image at the receiving end is lifelike, although not absolutely perfect. It is a glowing image, as though painted in fire, the light being that emitted by the neon lamp. Since eighteen complete images of the face or other scene are received every second, the illusion of motion is quite as perfect as in the motion picture, possibly more so. In radio transmission, it occasionally happens that two images appear side by side, one being a "ghost" of the other. This is ascribed by the engineers in charge to double transmission of the radio wave; one path direct and the other by reflection from the Heaviside Layer.

Experimental work directed toward perfection and application of television is actively under way in the Bell Telephone Laboratories. It is expected that the process, already the most successful demonstrated by anyone, will be still further improved.

Popular Radio hopes to present in later issues descriptions of some of the technical details of the present process and of its improvements.

Underwood

TESTING NOISE WITH A GAS MASK

In experiments now being conducted by Professor Donald A. Laird, of Colgate University, on the psychological effects of noise, typists will wear gas masks, so that gases discharged in the breath can be analyzed. This will permit measurement of the energy consumed by the body in performing a given amount of mental or physical work. Professor Laird hopes to discover how noise affects nervous or physical energy. (The background is of Acousti-Celotex, a material which absorbs sound and helps to prevent reverberation.)

Which Noises Annoy?

By analogy with the familiar definition of dirt, noise has been called "sound out of place."

Radio is accused, we fear all too rightly, of causing some of these displaced sounds; for example, the sidewalk loudspeaker. On the other hand, noise is one of the continual difficulties in broadcasting studios and in radio laboratories. No radio engineer can afford to forget the large amount of investigation which is now being done, both by physicists and engineers, in connection with noise problems.

At the very basis of these matters lie some problems of psychology which are still unsolved. It is not known what varieties of noise cause the greatest disturbance and distress to human beings. It is not known whether a noisy workroom increases or decreases the output of work or the expenditure of energy on the part of the worker. It is not known whether noise is tiring to persons who have become accustomed to it, or merely to those who have been used to quiet. These uncertainties offer opportunities for psychological experimenta-

(Continued on page 78)

★ PROGRAM FEATURES *for* THE MONTH

Here is Popular Radio's *selection of the "star" broadcast features that are scheduled as regular weekly events for the month beginning July 16—program numbers of outstanding merit that are selected on the basis of intrinsic worth, as well as upon their importance as determined by the large audiences reached by powerful single stations and by the chain stations that now cover the country. Every radio fan has—or should have—a receiver good enough to tune in on most of the features that are listed.*

(THE PROGRAMS GIVEN HERE ARE SCHEDULED ACCORDING TO EASTERN STANDARD TIME; FOR BROADCAST LISTENERS LIVING IN LOCALITIES THAT USE DAYLIGHT SAVING TIME, THE TIMES OF PERFORMANCE ARE AN HOUR LATER THAN EASTERN STANDARD TIME.)

Mondays

Roxy and His Gang; 7.30 p. m.; *110-piece symphony orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM.

The big musical jamboree of the week. Roxy and His Gang is the most ambitious broadcasting project yet attempted and it merits the attention of several million listeners. This program is made up of performances of individual artists, a huge chorus and a 110-piece symphony.

Hire's Harvesters; 8.30 p. m.; *instrumentalists and orchestra;* WJZ, WBZ, WBZA, KDKA, KYW, WBAL, WJR, WHAS, WSB, WSM, WMC.

The makers of a national beverage flood the country with snappy, good music. (Old listeners should note that Hire's Harvesters have changed from the red to the blue chain.)

Barrere Little Symphony; 9.00 p. m.; *ensemble; classical selections only;* WABC.

George Barrere, the director of this ensemble, is one of the greatest musicians appearing regularly on the air; he is the first flutist of the New York Symphony. He performs the seemingly impossible in playing the flute and conducting the orchestra at the same time. This organization is a real favorite with the musical enthusiasts of New York.

WBAL Staff Concert; 9.00 p. m.; *chamber music;* WBAL.

WBAL gathers its student talent for a little concert of good chamber music. WBAL, by the way, never disappoints its chamber music listeners.

WBAL Dance Orchestra; 10.00 p. m.; *dance music;* WBAL.

WBAL has for some time been known as a merchandiser of good dance music for late evening use.

Lido Venice Dance Orchestra; 10.10 p. m.; *jazz music;* WEEI.

A great dance orchestra with a great following. All of the dancing youngsters of New England swear by the Lido Venice's snappy, tuneful one-steps.

Coronada Orchestra; 1.00 a. m.; *dance music;* KMOX.

Those who dance late and strenuously will do well to try the Coronada Orchestra.

Tuesdays

Dinner Concert; 6.30 p. m.; *classical and semi-classical music;* WGY.

WGY's dinner concerts are always an aid to digestion and appetite. This music is relayed from the dining-room of Hotel Ten Eycke, Albany's finest hostelry.

WBAL Dinner Music; 6.30 p. m.; *chamber music;* WBAL.

More good dinner music from WBAL's Staff Ensemble.

George Olsen's Stromberg-Carlson Orchestra; 8.00 p. m.; *dance music;* WJZ, WBZ, KDKA, KYW.

George Olsen with a lot of musical stunts and some serious syncopation, if any syncopation can be called "serious." Mr. Olsen is perhaps one of the most ingenious orchestrators performing in the jazz industry, and his Tuesday night concerts are always an inspiration to those who are entertained by such music.

Edison Ensemble; 8.00 p. m.; *classic and popular music;* WRNY.

The great New York Edison Company, with a good-will program, has been a favorite with the New York public for the last year.

Great Moments in History; 8.30 p. m.; *historical events reenacted;* WEAF, WFI, WRC, WTAM, WWJ, WOC.

The invention of a Columbia University professor, with a bit of music thrown in for good measure. If you don't know your onions in history, here's your chance.

Grand Opera Program; 9.00 p. m.; *soloists and instrumentalists;* WJZ, KDKA, KYW.

This is the National Broadcasting Company's own program of heavy music, participated in by soloists and instrumentalists of standing. The material used in this program is usually made up of excerpts from the most popular operas. Naturally, the time limit does not permit the broadcasting of a complete opera.

Eveready Hour; 9.00 p. m.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WRC, WGY, WHAS, WSM, WSB, WMC, WTAG.

The summer music offered by the Eveready Hour is invariably made up of the Eveready Orchestra and a few soloists. The best offerings of this organization is put forth during the cooler months. Virginia Rea is the soprano of this group of artists.

Educational Program; 9.00 p. m.; *lectures;* WLWL.

WLWL becomes the big red schoolhouse of the air, with all sorts of professors talking about all sorts of things which should interest normal human beings.

Mixed Quartet; 9.00 p. m.; *popular ballads;* WBAL.

An old-fashioned quartet with old-fashioned ideas about ballads.

Sam 'n' Henry; 9.00 p. m.; *negro comedy;* WGN.

Nigger talk and songs by two masters of negro psychology.

WBAL Dance Orchestra; 10.00 p. m.; *popular selections;* WBAL.

The WBAL dance orchestra fills the time that used to be filled by the Baltimore Municipal Band.

VITROHM RESISTORS

—in power supply units

35 years of research and experience in the manufacture of resistors is incorporated in Vitrohms for radio.

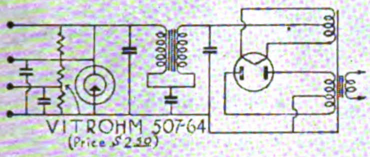
There are available Vitrohms to give you noiseless, dependable service wherever resistance is indicated in a current or power supply circuit.

Vitrohms do not age or change in resistance value after use. Ten, twenty or thirty years of constant use under all conditions are every-day records of Vitrohms.

SILVER-MARSHALL

652 RESERVOIR B SUPPLY

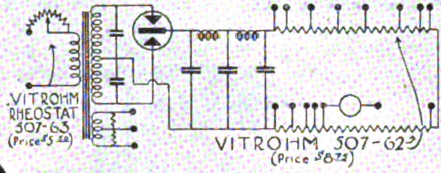
*Uses Vitrohm Resistor 507-64**



RAYTHEON A-B-C

350 m.a. CURRENT SUPPLY UNIT

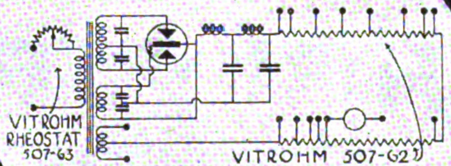
*Uses Vitrohm Resistor 507-62**
and Vitrohm Rheostat 507-63

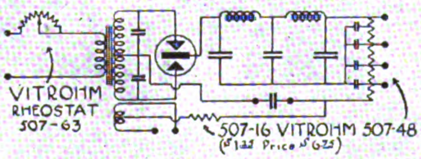


Q R S A-B-C

400 m.a. CURRENT SUPPLY UNIT

*Uses Vitrohm Resistor 507-62**
*and Vitrohm Rheostat 507-63**





Q R S and RAYTHEON

85 m.a. CURRENT SUPPLY UNIT

Uses Vitrohm Resistors
507-16 and 507-48**

Vitrohms are "pre-aged" wire wound on porcelain tubes and protected by fused-on vitreous enamel for the permanent protection of resistance wire and terminals.

Per square inch of surface, Vitrohms have greater watt dissipation than any other resistor.

Send 15c for "How To Use Resistance in Radio." It contains many circuits of interest to all experimenters. Bulletin 507 describing Vitrohms for radio is sent without charge upon request.

* Approved by the Raytheon and Q R S Laboratories.

Ward Leonard Electric Company

37-41 South Street Mount Vernon, N. Y.

Coca Cola Girl; 10.00 P. M.; *orchestra and continuity;* WEAF, WEEI, WGR, WFI, WRC, WCAE, WWS, KSD, WHAS, WSM, WMC, WMAQ.

Miss Coca Cola steps out of the billboard into the studio of WEAF accompanied by a special orchestra and continuity about trips to the circus, the seashore and other places where people get hot and drink Coca Cola. There is a persistent rumor that the young lady who takes the part of the Coca Cola Girl is not nearly as beautiful as the original. However, she sings well, and perhaps the girl on the billboard can't do that.

Don Amaizo; 10.00 P. M.; *violinist;* WJZ, KDKA, KYW, WCCO.

A cooking oil manufacturer's idea of romance, with Godfrey Ludlow playing a romantic violin. While the continuity of this program is far from being anything to get excited about, the violin playing is well worth listening to.

Frank Carroll Orchestra; 10.30 P. M.; *dance music;* WGBS, WIP.

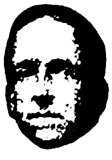
The Arrow Head Inn Orchestra has been supplanted by Frank Carroll's Jazz Makers.

Wednesdays

Dinner Concert; 6.45 P. M.; *chamber music;* WSM.

WSM opens its Wednesday evening program with a half-hour of good dinner music. Those who like the old-fashioned Southern airs, played by Southern musicians, will do well to tune to this particular feature.

Radio Nature League; 7.30 P. M.; *nature talks;* WBZ.



Thornton Burgess, and other close followers of capricious nature, lecture to the multitude about birds, bees, snakes and all the other children and denizens of the forest and fields.

Katz and His Kittens; 8.00 P. M.; *dance orchestra;* WQJ.

Harry Katz and his playful kittens with a half-hour of rousing dance music.

Steindal String Quartet; 8.30 P. M.; *semi-classical music;* KMOX.

Another one of the prides of St. Louis radiating some of the "Spirit of St. Louis" in the form of classical music.

Remington Typewriter Band; 8.30 P. M.; *typical band selections;* WGY.

Edwin L. Daniels directing the smart band of the Remington Typewriter Company from the shell band-stand at Ilion.

Ipana Troubadours; 9.00 P. M.; *dance music;* WEAF, WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD, WCCO, WDAF, WGY.

Of all the jazz orchestras to appear on the broadcast chains, none has been quite so popular as the Ipana Troubadours.

Maxwell Hour; 9.00 P. M.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW, WHAS, WSB, WMC, WSM.

The brilliant strains of the special Old Colonel march written by Nathaniel Schilkret, the director of the Maxwell orchestra, is always the signal for the beginning of an hour of especially fine music. Perhaps no other single feature is followed more closely or keenly by the music lovers of airdom.

David Lawrence; 10.00 P. M.; *"Our Government," lecture;* WEAF, WGR, WRC, KSD, WGY, WMAQ, WEEI, WTAG.

David Lawrence knows a lot about the United States Government that about 100,000,000 other people don't know, and he knows how to tell it.

Ensemble; 10.00 P. M.; *classics;* WABC.

If you see anything having to do with the classics mentioned on the program of WABC, always tune to it, and bet your bottom dollar on its quality.

RCA Radiotrons; 10.00 P. M.; *songs and comedy;* WJZ, WBZ, KDKA, WEBH.

The Radio Corporation of America tries to do right by broadcasting what is always a highly novel and entertaining period of song and comedy, participated in by artists of no small fame.

Sunset Instrumental Quartet; 10.00 P. M.; *popular numbers;* KFI.

More California propaganda, supplied by a "native son" orchestra.

National Light Opera Company; 10.10 P. M.; *tabloid versions of well-known light operas;* WEAF, WLIT, WRC, WCAE, WGY, WGR, KSD.

Carefully edited vest-pocket editions of light operas supplied by the National Broadcasting Company.

Hogan's Dance Orchestra; 11.00 P. M.; *dance program;* WOR.

To say that this orchestra is one of a comparatively large number of good dance orchestras in New York is saying about all that could be said without risk of exaggeration.

Bamboo Garden Orchestra; 11.00 P. M.; *dance music;* WTAM.

Cleveland's idea of a rip-snorting jazz band, playing all of the modern rip-snorting pieces.

Thursdays

WBAL Dinner Music; 6.30 P. M.; *classical and semi-classical selections;* WBAL.

WBAL supplies a little music for the sunset with great success.

Coward Comfort Hour; 7.30 P. M.; *solos and orchestra;* WEAF.

Just an hour of good old-fashioned music.

Concert Ensemble; 7.35 P. M.; *chamber music;* WGN.

Chicago broadcasting gets out of its element and supplies a little very stimulating chamber music. This probably sounds very strange to the listeners in the Capitol of Air Jazz.

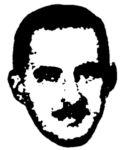
Cadillac-La Salle Symphony; 8.00 P. M.; *small symphony orchestra;* WEAF, WEEI, WSAR, WTAG, WTIC, WGR, WSAI, WCSH, WCAE, WTAM, WWS, WFI, KSD, WGY, WHAS, WSM, WSB, WMC, WMAQ.

General Motors spends big dough on a small symphony, with results highly pleasing to the dial twisters. In listening to this small symphony, one is reminded of the very entertaining program supplied by Henry Hadley's little symphony when it was playing on the Willys-Overland program.

WBAL Ensemble; 9.00 P. M.; *chamber music;* WBAL.

Once again WBAL throws a precious mite into the broadcasting plate.

Clicquot Club Eskimos; 9.00 P. M.; *banjo ensemble;* WEAF, WEEI, WCCO, WGN, WCAE, WGY, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ.



Zip! Bang! Smash! Who can say that the Eskimo banjo ensemble is not one of the most stirring features on the air? They are as effervescent as the beverage they advertise.

Fuller Orchestra; 9.30 P. M.; *popular music;* WGHP.

It is very difficult to pick a good jazz orchestra from all the good, bad and indifferent jazz bands playing in Chicago. The editor of Popular Radio is assured that this is a particularly good jazz orchestra.

Goodrich Silver Masked Tenor and Orchestra; 10.00 P. M.; *popular music;* WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WCSH, WADC, WHAS, WSB, WSM, WMC.

The Silver Masked Tenor returns to the air, with Joseph Knecht directing the famous Goodrich Orchestra. Joseph Knecht used to direct a small ensemble that played dinner music at the Waldorf-Astoria dining-room. His musical education was received in Austria-Hungary and he is one of those solid European directors whose musical experiences would fill a book.

Hotel Bossert Orchestra; 11.00 P. M.; *popular dance orchestra;* WEAF, WGY.

The good ship "Bossert" once again sails forth from the marine roof of Hotel Bossert in Brooklyn. This used to be a very good program, and rumor has it that it is still better.

KFI Drama Hour; 11.00 P. M.; *varied program;* KFI.

Heavy drama supplied by a station that goes in for very little of that sort of thing. This particular period used to be filled by KFI Music Box Hour.

Fridays

Hotel Bretton Hall Orchestra; 6.30 P. M.; *chamber music;* WOR.

The editor of this column never listens to anything else at 6.30 P. M. on Friday evening.

Dinner Orchestra; 6.30 P. M.; *popular selections;* WBAL.

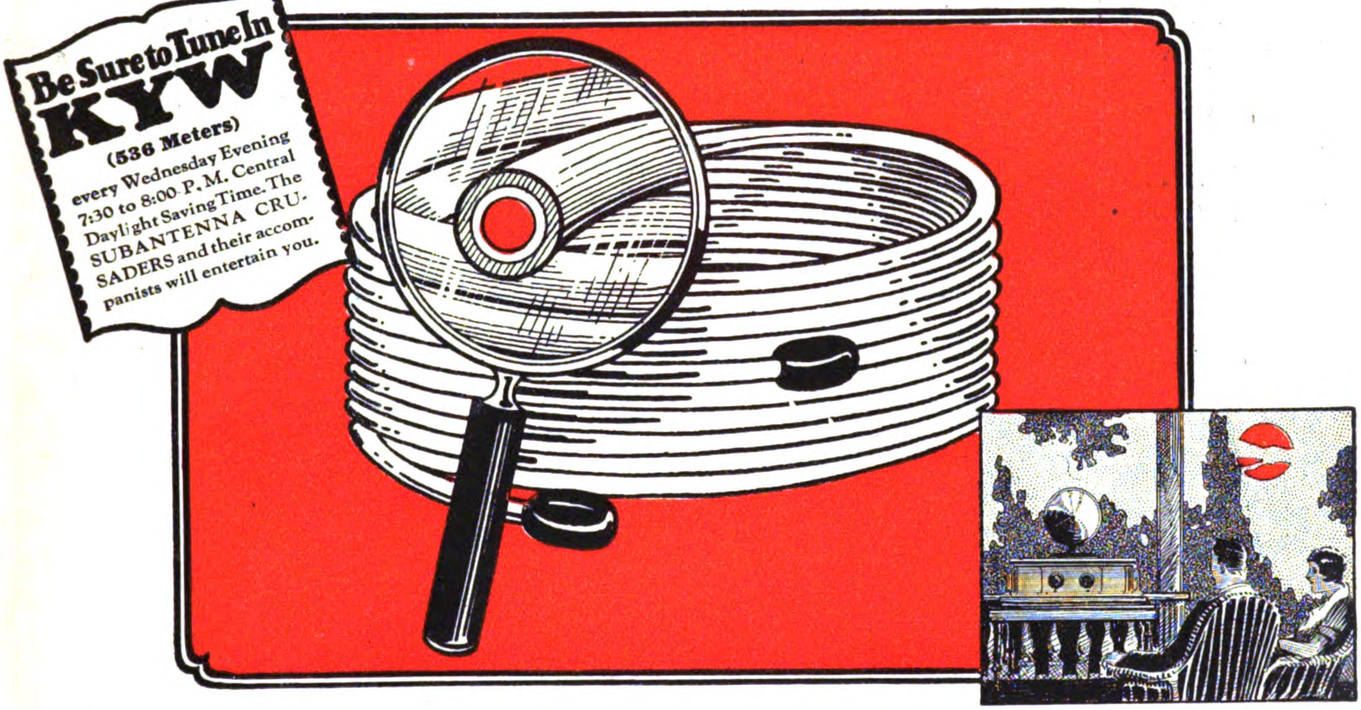
WBAL again steals in with a little dinner concert, carefully chosen and well played.

King Edward Hotel Orchestra; 6.35 P. M.; *chamber music;* CNRT Hotel.

The western New Yorkers will do well to sample this morsel of Canadian musical luxury.

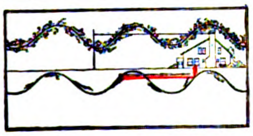
SUBANTENNA

UNDERGROUND ANTENNA SYSTEM



Be Sure to Tune In
KYW
(536 Meters)
every Wednesday Evening 7:30 to 8:00 P.M. Central Daylight Saving Time. The SUBANTENNA CRUSADERS and their accompanists will entertain you.

Gets Distant Stations Clear *and* Loud— Summer *and* Winter—Right thru Static



NOW—you can get "distance" in summertime. Loud, clean, clear distance, sweet and true in tone—almost like local. The marvelous new device illustrated above makes this possible. STATIC is no longer a nuisance. Engineers have long known that the ratio of static strength to signal strength IN THE AIR, favored Static, but that in the GROUND, the ratio of static strength to signal strength favored the music you wish to hear. They knew that if some device could be perfected whereby broadcast waves could be taken out of the GROUND instead of from the air, that all-year-'round distant reception would become a reality. SUBANTENNA is the answer. It completely does away with the old style up-in-the-air aerial; it picks up clear, filtered waves from the ground—it delivers a strong signal: waves so powerful that the tiny amount of weak ground static they may contain is drowned out. The performance of SUBANTENNA is nothing short of marvelous. It will amaze you—just as it has amazed laboratories and thousands of critical fans.

User Says "Static Is No More"

"I have received the Subantenna. My grandson installed it. STATIC IS NO MORE. Am well satisfied. I can tune in stations I never could coax out of the air even though I had a long aerial."—A. E. F., Kans.

User Says "Greater Distance"

"To show you that I received a program from Station PWX in Havana, Cuba, I enclose herewith a verification card from that station. On January 28th, I received a program on my set broadcasted from Buenos Aires, South America at 10:15 in the evening. Many other long-distance stations have been heard on my set after installing the Subantenna. I never could receive such distance on my outside antenna."—W. C. F., Chicago, Ill.

User Says "Gets More Stations"

"I get plenty of stations with my Subantenna, on the loud speaker that I have never been able to reach with my outside aerial. It absolutely cuts down interference to the minimum, cuts static out too—not just partly out—but *all* out."—H. S. M., N. Car.

User Says "Cuts Out Interference"

"Have had Subantenna some months and it beats any antenna I have ever had by forty miles. Have a five tube set and get New York City, Atlantic City, Atlanta, New Orleans, Fort Worth, Denver perfectly clear, and next to an elevated train with much interference. Cuts it all out."—C. H. Y., Chicago.

User Says "More Volume"

"We have been receiving stations that formerly did not register on the outside antenna. A marked increase in volume on Stations over 800 Kilocycles has been noted."—Capt. F. W. F., Md.

Eliminates Lightning Risk

Not only does SUBANTENNA make possible loud, clear DX in summer—not only does this remarkable invention better the selectivity of any set—but it also completely eliminates the Lightning hazard. With SUBANTENNA one can go right on listening-in during the most severe electrical storm without noise, fear of attracting lightning or damaging the set.

FREE TRIAL

Make This Convincing Test

Install SUBANTENNA. Leave your old aerial up. Select a bad night when DX is almost impossible with the ordinary aerial. Make a comparison station for station, connecting first your aerial, then SUBANTENNA. If, from stations that are just a mess of jumbled noise with the old aerial, you don't get reception that rivals local in sweetness and clarity the instant you switch to SUBANTENNA, this test won't cost you even a single penny. Obtain a SUBANTENNA from your dealer or send coupon at once for scientific explanation of SUBANTENNA and for particulars of GUARANTEE and FREE TRIAL OFFER. Send COUPON NOW!

CLIP AND MAIL AT ONCE

CLOVERLEAF MFG. CO.,
2715-K Canal Street, Chicago, Illinois

Tell me all about SUBANTENNA, your unqualified, unconditional guarantee and your FREE TRIAL OFFER.

Name ....

Address ....

....

CLOVERLEAF MANUFACTURING CO.

2715-K CANAL STREET **CHICAGO, ILLINOIS**

Happiness Boys; 7.30 p. m.; *songs and jokes;* WEAF.

Yes, they are still here—those two oldtimers—the Happiness Boys: Billy Jones and Ernie Hare. "How do you do, everybody, how do you do!"

Hotel Whitehall Trio; 7.45 p. m.; *string trio playing classics and semi-classics;* WABC.
Isn't it strange how good three string instruments can be made to sound when they are played by men who know how to play them?

Chelsea Concert Orchestra; 8.00 p. m.; *chamber music;* WPG.
A great Atlantic City boardwalk hotel permits listeners of the United States to sample its dinner music.

Royal Hour; 8.30 p. m.; *orchestra and soloists;* WJZ, WBZ, KDKA, KYW.
The Royal Typewriter Company out for customers with a half-hour of music that has set up new standards.

Philco Hour; 9.00 p. m.; *vocal and orchestral;* WJZ, WBZ, WBZA, KDKA, KYW.
Another radio manufacturer trying to pay its debt to broadcasting.

La France Orchestra; 9.30 p. m.; *popular orchestral music;* WEAF, WGR, WLIT, WOC, WCAE, WTAM, WWJ, KSD, WDAF, WMAQ.

Anne Byrne still at it with her very, very, very popular orchestra.

Moonlight Sextet; 10.00 p. m.; *vocal and instrumental music;* WJZ, WBZ.
The Moonlight Sextet is just another way of saying the Armchair Hour. Keith McLeod still performs on the Vibraphone just as if he was quite sure that his audience liked it.

Dance Orchestra; 11.00 p. m.; *dance music;* KDKA.
Real good dance music emerging from the smoke of Pittsburgh.

Saturdays

Jacques Renard's Orchestra; 6.45 p. m.; *dance music;* WEEI.
One of two particularly good dance orchestras broadcasting from the Bean City.

String Ensemble; 7.40 p. m.; *classical music;* WGBS.
WGBS's own string ensemble with a comforting hour of classical music.

Hotel Traymore Concert; 9.00 p. m.; WPG.
An Atlantic City hotel supplying the public with a lot of good concert music.

Benjamin Franklin Orchestra; 10.05 p. m.; *chamber music;* WIP.
Benjamin Franklin Orchestra has been one of the favorites of the editor of this column for a long time and he can recommend it with a feeling that he cannot be taken as an easy musical customer.

Arcadia Dance Orchestra; 12.00 m.; *dance music;* KMOX.
KMOX stirs the midnight air with a big dance band.

Colorado Orchestra; 12.30 a. m.; *dance music;* KOA.
This orchestra is the pride of Denver and of KOA.

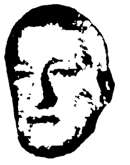
Sundays

KFI Midnight Frolic; 3.00 a. m.; *musical jamboree;* KFI.
KFI breaks loose with an after-theatre show of pretentious proportions. This air entertainment takes the form of an air vaudeville show with many actual vaudeville entertainers involved.

Crosley Radio Feature (alternate weeks); 5.30 p. m.; *Moscow Art Orchestra;* WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.
The Crosley Radio Hour with the Moscow Art Orchestra calls for applauding with elevated hands and shouts of "Bravo."

Park V. Hogan Organ Recital; 7.00 p. m.; *organ and vocal;* WJZ, WBAL.
The old WJZ stand-by, with Park Hogan, the official Estey organ concert master, at the console.

The Capitol Grand Orchestra (and Major Bowes' family); 7.20 p. m.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG, WHAS, WSB, WSM, WMC.



The big Sunday feature, with 100-piece symphony and all kinds of vocal and instrumental talent turned loose. Major Bowes is Master of Ceremonies. Among Major Bowes' outstanding artists is Wee Willy Robyn, often called the "little man with the big voice."

Della Robbia Concert; 7.45 p. m.; *chamber music and solos;* WOR.
Here is a restful hour of music well fitted to a Sunday afternoon mood.

Cook's Tours; 8.30 p. m.; *travelogue with music;* WJZ.
Here's an opportunity to learn something about the other half of the world and how it likes its music.

Ambassador Concert; 9.10 p. m.; *chamber music;* WPG.
WPG must have a hard time trying to find room for all the Atlantic City hotel orchestras on its program.

Atwater Kent Hour; 9.15 p. m.; *star soloists;* WEAF, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSP, WMC.

Although the Atwater Kent Hour is not as good in the summer time as in the winter time, it is good enough in the summer time to listen to regularly. The conductor is Niccolai Berezowski.

WABC Hour of Dance Music; 11.00 p. m.; *popular dance music;* WABC.
WABC deals in nothing but high-grade dance music.

Schedules of Dinner-Hour and Dance Programs of Special Note

★ Programs of Dinner-Hour Music

(Eastern Standard Time)

FEATURE	STATION	TIME
Palmer House Victorians	WEBH	7:15 P. M.; *daily except Sundays.*
Hotel Andrew Jackson Concert	WSM	7:15 P. M.; *Tuesdays;* 6:45 P. M.; *Wednesdays and Thursdays.*
Neopolitans	WTAM	6:00 P. M.; *Wednesdays and Thursdays.*
Emerson Gill's Orchestra	WTAM	6:00 P. M.; *Fridays.*
Bem's Little Symphony	KGO	9:00 P. M.; *daily except Saturdays.*
Kats and His Kittens	WQJ	8:00 P. M.; *daily except Sundays and Mondays.*
Hotel Tuller Concert	WGHP	7:00 P. M.; *daily except Sundays.*
WBAL Dinner Concert	WBAL	6:30 P. M.; *Tuesdays, Thursdays and Fridays.*
Joe Rine's Orchestra	WEEI	6:05 P. M.; *Mondays, Wednesdays and Thursdays.*
Jack Renard's Orchestra	WEEI	6:45 P. M.; *Saturdays*
Mack's Collegians	KFI	9:30 P. M.; *Saturdays.*
Ray Fisher's Orchestra	KFI	10:00 P. M.; *Wednesdays.*
Concerts from Atlantic City Hotels	WPG	7:25 P. M.; *daily except Sundays.*
Special Dinner Programs	WBZ	7:00 P. M.; *daily.*
KDKA Little Symphony	KDKA	6:00 P. M.; *Tuesdays, Thursdays*
Coronado Orchestra	KMOX	7:00 P. M.; *Sundays.*
Drake Concert	WLIB	8:00 P. M.; *Tuesdays, Thursdays and Saturdays.*
Drake Concert	WGN	7:35 P. M.; *daily except Sundays.*
Colorado Orchestra	KOA	12:30 P. M.; *Saturdays.*

★ Programs of Dance Music

(Eastern Standard Time)

FEATURE	STATION	TIME
Packard Six Orchestra	KFI	1:00 A. M.; *Monday mornings.*
Coronado Orchestra	KMOX	1:00 A. M.; *Mondays, Tuesdays, Wednesdays, Fridays, Saturdays.*
Frank Carroll Orchestra	WGBS, WIP	10:30 P. M.; *Tuesdays and Saturdays.*
McDonald Recording Orchestra	WGBS, WIP	10:30 P. M.; *Thursdays.*
Van Horn Dance Hour	WPG	10:30 P. M.; *Fridays.*
Casino Dance Orchestra	WPG	11.30 P. M.; *Saturdays and Mondays.*
Silver Slipper Orchestra	WPG	11:30 P. M.; *Tuesdays.*
Golden Pheasant Orchestra	WTAM	10:15 P. M.; *Sundays.*
Emerson Gill Orchestra	WTAM	10:00 P. M.; *Mondays and Wednesdays.*
Far East Orchestra	WTAM	11:00 P. M.; *Thursdays.*
Bamboo Garden Orchestra	WTAM	11:30 P. M.; *Wednesdays and Fridays.*
Simovar Orchestra	WENR	1:00 A. M.; *Thursday, Friday and Saturday mornings.*
Midshipmen Orchestra	KGO	12:30 P. M.; *Thursdays.*
Kats and His Kittens	WQJ	10:00 P. M.; *Saturdays, Tuesdays, Wednesdays, Thursdays and Fridays,*
WBAL Dance Orchestra	WBAL	10:00 P. M.; *Mondays, Tuesdays, Thursdays and Fridays.*
Renard's Orchestra	WEEI	10:05 P. M.; *Mondays;* 6:45 *P. M.; Saturdays.*
Joe Rine's Orchestra	WEEI	10:05 P. M.; *Wednesdays.*
Nighthawks	WBBM	1:00 A. M.; *Mondays;* 12:00 P. M.; *Tuesdays and Thursdays.*

POPULAR RADIO Urges Its Readers to Apply Radio Amplification to Phonograph Records

Amazing results now possible, in quality and volume, with standard audio-frequency equipment. POPULAR RADIO to feature long series of articles beginning with this Issue.

IN this advertisement, POPULAR RADIO sets a precedent; for never before has a radio magazine attempted to "sell" its readers on new radio developments in space outside editorial bounds. This unique method of making editorial announcements was chosen only after it was decided that the publication, if it was to be of maximum service to its readers, should tell them of this new development in the most direct and convincing manner. In urging its readers to construct radio amplifiers for their phonographs, POPULAR RADIO feels that it is dispensing advice that will be deeply appreciated by lovers of good music and by those radio fans who are looking for new fields to conquer.

Any old phonograph may be used if the spring motor is operative. This, with an electrical pick-up, used in place of the old tone chamber, and a modern audio-frequency amplifier and loudspeaker will afford reproduction of almost unbelievable quality and volume. This is especially true with the new electrical cut phonograph records, although old records give amazing results. Such reproduction is rich, mellow, sonorous and perfectly *scratchless.* It marks the Renaissance of the phonograph; music from the plaintive whisper of a violin to the full crescendo of the New York Symphony Orchestra, with a fidelity of tone never before dreamed possible by acoustic engineers. Once more the phonograph becomes a potential source of entertainment through the employment of radio equipment. Now, if a storm is brewing or the music on the air does not fit the mood, there is left a way to round the evening out with entertainment of a high order. Radio has found its running mate.

In suggesting the use of this new principle, the Engineering staff of POPULAR RADIO cannot too strongly recommend the use of the most modern amplifying apparatus of either the transformer, resistance or impedance-coupled types. The results with amplifiers built two or three years back are bound to be disappointing. Radio has entirely outgrown the reproduction of yesterday and the discriminating fan will not be satisfied with anything but *today's* results; results easily available to every reader of this publication by the use of standard radio devices.

This new development in the art, although an astounding engineering achievement, has not become generally known to the alert radio fan, and so confident is POPULAR RADIO that he will be anxious to know of it that it has taken this unusual means of informing him.

POPULAR RADIO
627 West 43rd Street
New York, N. Y.

POPULAR RADIO ***will be glad to send a list of approved phonograph pick-up units to those who are interested***

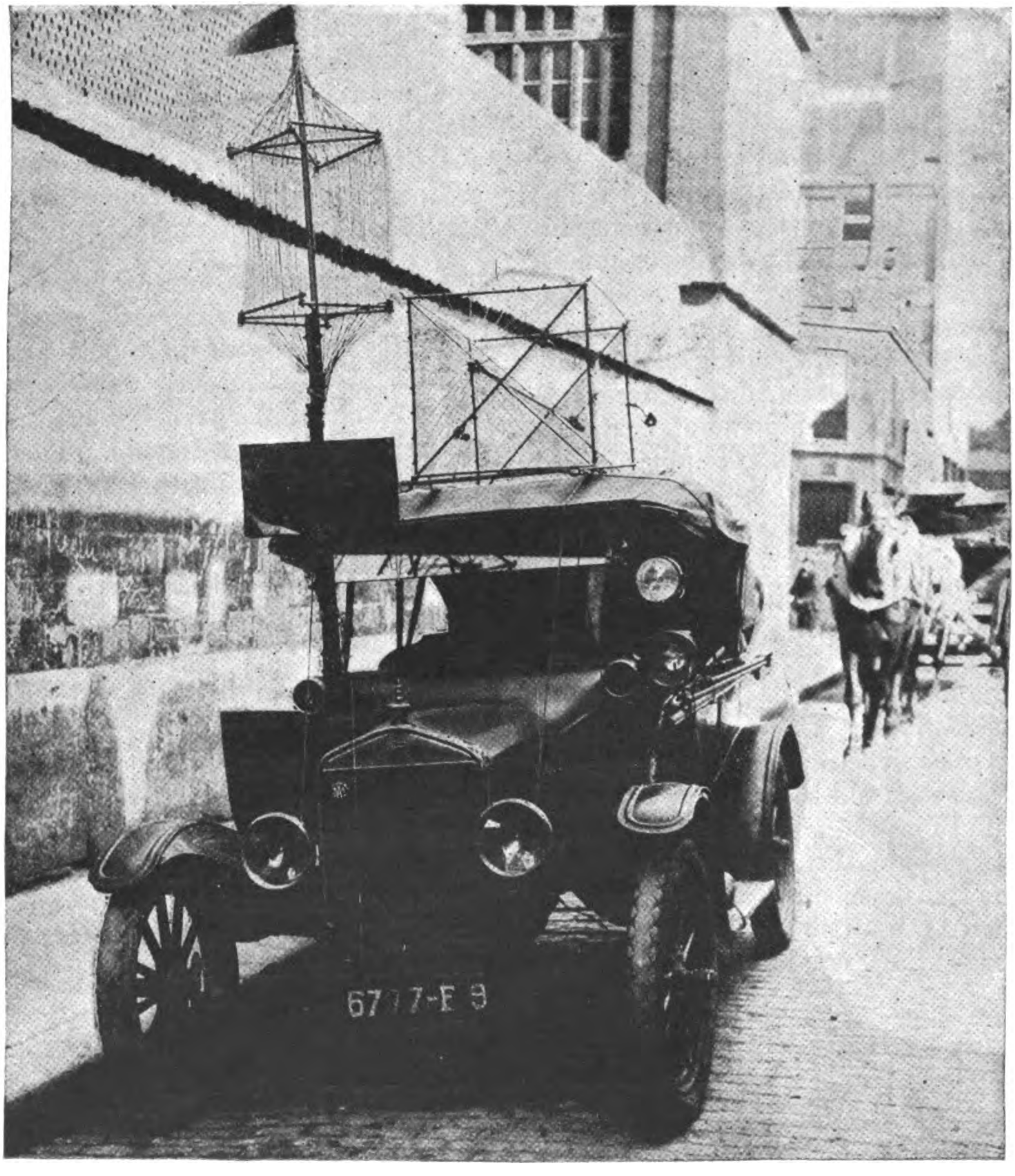
Schedules of Dinner-Hour and Dance Programs of Special Note

★ Programs of Dance Music
(Eastern Standard Time)

FEATURE	STATION	TIME
Brown Palace Orchestra	**KOA**	8:30 P. M.; *daily except Thursdays.*
Benjamin Franklin Orchestra	**WIP**	6:10 P. M.; *Thursdays;* 10:05 P. M.; *Saturdays.*
McDonald's Orchestra	**WIP**	6:10 P. M.; *Mondays and Fridays.*
Bretton Hall String Quartet	**WOR**	6:30 P. M.; *Fridays.*
Dinner Concert	**WWJ**	6:00 P. M.; *except Saturdays and Sundays.*
Jack Jacobs Orchestra	**WOR**	6:15 P. M.; *Mondays, Wednesdays, Thursdays and Saturdays.*
Twilight Musical	**WAIU**	7:00 P. M.; *Mondays, Tuesdays and Wednesdays.*

★ Programs of Dinner-Hour Music
(Eastern Standard Time)

FEATURE	STATION	TIME
Vincent Carr Orchestra	**WIP**	10:05 P. M.; *Saturdays.*
Vanderbilt Dance Orchestra	**WOR**	11:35 P. M.; *Tuesdays.*
Cass Hogan's Orchestra	**WOR**	11:00 P. M.; *Wednesdays and Saturdays.*
Fletcher Henderson's Orchestra	**WOR**	11:00 P. M.; *Fridays.*
Kentucky Serenaders	**KYW**	11:30 P. M.; *Saturdays.*
Roger Kahn's Orchestra	**WJZ**	10:30 P. M.; *Tuesdays.*
Goodrich Zippers	**WEAF**	10:00 P. M.; *Thursdays.*
Lido Venice Orchestra	**WEEI**	10:10 P. M.; *Mondays.*



HE MAY HAVE MUSIC WHEREVER HE GOES

With antennas of his own making strung up on his car, this French radio merchant drives about the boulevards of Paris, on Sundays, giving a free radio concert, picked up from a broadcasting station, as he goes. It is not only a good way of spending the holiday, but affords him considerable advertisement, as his radio shop makes a specialty of ready-built cage antennas.

With the Experimenters

(Continued from page 61)

It would be possible to run the rheostat direct to the two high-frequency valves, but where the amperite is connected in series with the rheostat it acts as a safeguard to prevent overloading of the filament.

To control the filament current of the detector valve and the first low-frequency valve a No. 112 amperite, or any other approved ½-ampere automatic filament control, should be installed as shown in Figures 2 and 4.

Automatic Control of the Panel Light

IN the original arrangement the lamp of the illuminated tuning control of the LC-27 receiver was turned "on" and "off" by its individual switch.

By making the change as indicated in Figure 2, this lamp will be automatically turned "on" and "off" by the action of the battery switch on the receiver, and therefore serves as an actual "pilot light" to give visible indication when the set is "on" or "off."

The change required to accomplish this is simple. The lead from the frame of the dual condenser should be connected to the receiver side of the battery switch instead of the "A" negative (—) terminal in the rear of the receiver, as shown in the original diagram.

The lamp on the new-type Marco illuminated tuning control is entirely insulated from the metal frame. In this case one side of the lamp should be connected to the receiver side of the battery switch and the other connections may be followed out as shown in the original diagram.

In this arrangement there will be no further use for the individual switch of the pilot light, and it should therefore be left "on" at all times.

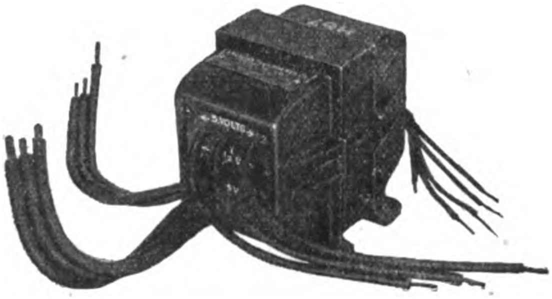
—CARL DORF

The First Transmission Without Antennas

FOR the first time on record two radio stations have communicated with each other over a distance of 900 miles without using transmitting antennas. On April 2nd, while Naval Research Laboratory station NKF, at Bellevue, near Washington, was communicating with the Naval Reserve station 4 XE, operated by Lieutenant-Commander W. J. Lee, USNR, at Winter Park, Fla., its aerial was disconnected. Only a slight decrease in the incoming signal strength was noted by Commander Lee at Winter Park, who then disconnected his own transmitting antenna. The two-way, break-in communication continued uninterrupted, although both stations were making use of only their helices as radiating systems.

AMERTRAN } AMERTRAN } AMERTRAN

Two New AmerTran Power Transformers for Use With New Tubes!



AmerTran Filament Heating Transformer
Type H-67, $12.00 each

THIS transformer is intended for use with the new RCA UX-226 raw AC amplifier tubes and the new UY-227 detector tube. It also has a third filament winding capable of handling two UX-171 tubes. In connection with the new AC tubes, the type H-67 becomes the power source for the filament and is therefore a real "A" battery eliminator.

If you have a good plate supply system and a set with the new AC tubes and one or two UX-171 power tubes in the last state, the H-67 AmerTran is ideal, transforming the 50 or 60-cycle, 110-volt AC house light current down to the lower voltages for the correct operation of the new tubes.

AmerTran Power Transformer
Type PF-281

This unit is designed for use with the new UX-281 rectifying tube, which can be operated at 550 volts plate up to a maximum of 750 volts plate and deliver 110 milliamperes DC as a half-wave rectifier. A 750-volt plate winding with a tap for 550 volts enables the transformer to be used either with a UX-281 or 216-B rectifying tube, where the output plate voltage is not required to be in excess of 450 volts.

In addition to the plate and filament windings for the rectifier and power tubes, the type PF-281 has filament heating windings (similar to the H-67) for the new AC tubes, and thereby incorporates in a single transformer unit the means for converting AC house current into filament and plate current and grid bias potential. When used with our type 709 and 854 Amer Chokes in the filter circuit, it is possible to construct a radio receiver which can be operated entirely from the house lighting circuit without an "A" eliminator, trickle charger or batteries.

Like all AmerTran power devices, this transformer has been generously designed to operate at a very low core density, reducing the hum from stray fields to a minimum. Utmost efficiency has been sought regardless of cost.

Write for further information, including booklet "Improving the Audio Amplifier"

American Transformer Co.
178 Emmet Street Newark, N. J.
"Transformer Builders for Over 26 Years"

AMERTRAN } AMERTRAN } AMERTRAN

FREE
Simplified
BLUE
PRINTS

You can have your choice of any one set of POPULAR RADIO Simplified Blueprints with your new or renewal subscription for POPULAR RADIO, accompanied by remittance of $3.00. These Blueprints will make it possible for you to build a tested and approved set. You, as a reader of POPULAR RADIO, know the many entertaining, interesting and instructive articles that are published each month. We promise that throughout the coming months POPULAR RADIO will hold more and more of interest for Radio Fans.

Ease, Economy and Accuracy in Construction

Simplified Blueprints make it possible for anyone, without previous knowledge of radio, to construct a highly efficient radio receiver. These Blueprints consist of 3 diagrams as follows:

Panel Pattern

This Blueprint is the EXACT size of the actual set. So accurate that you need merely lay it on your panel and drill as indicated. No scaling or measuring to do, no danger of ruining the panel through faulty calculation.

Instrument Layout

Here again you have an actual size print of each instrument and binding post and its exact location both on the panel and within the cabinet.

Wiring Diagram

The unusual feature of this Blueprint is that it is an actual size picture diagram of the finished set. Each instrument and other parts appear in exact size and the wires are so clearly traced from one contact to another that you can connect all terminals accurately without even knowing how to read a hook-up diagram.

Set No. 18—*"The Improved Raytheon Power-Pack"* (as described in the May, 1926, issue of POPULAR RADIO).
Set No. 22—*"The LC-27 Broadcast Receiver"* (as described in the October, 1926, issue of POPULAR RADIO).
Set No. 23—*"The LC-Senior Power-Pack"* (as described in the November, 1926, issue of POPULAR RADIO).
Set No. 24—*"The LC-Intermediate Power-Pack"* (as described in the December, 1926, issue of POPULAR RADIO).
Set No. 25—*"The LC-Junior Power-Pack"* (as described in the January, 1927, issue of POPULAR RADIO).

Use coupon below; indicate which set of Blueprints you want.

POPULAR RADIO
Dept. 49
627 West 43rd Street New York City

POPULAR RADIO, Dept. 49
627 West 43rd Street, New York City

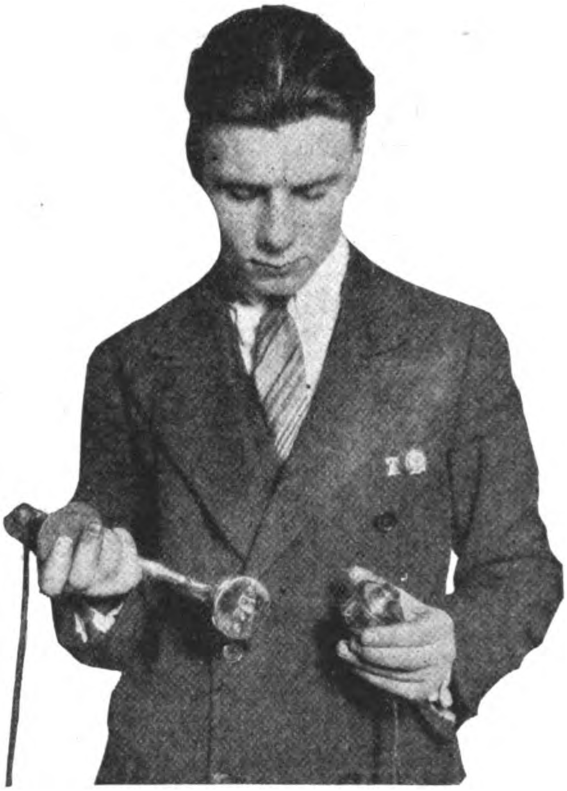
Enclosed is my remittance of $...... in full payment for subscription, with Blueprints as checked below, FREE.

☐ Set Number 18 ☐ Set Number 23
☐ Set Number 22 ☐ Set Number 24
☐ Set Number 25

Name.................................
Street.................................
City.................... State..........

How to Add the New Radio Amplification Units to Your Phonograph

(Continued from page 17)



TWO MORE ELECTRICAL "PICK-UP" UNITS

FIGURE 8: *Held in the right hand is the new Tectron magnetic pick-up device, while in the left hand is the small and compact Alden electrical pick-up unit that contains a volume control. (Matched combinations of apparatus that use these two units and the one shown in Figure 9 will appear in the August issue of* POPULAR RADIO.)

the diagrams shown, the apparatus recommended by the designer has been used and has successfully produced the results described.

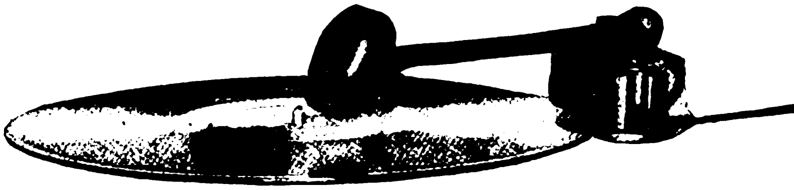
There are a variety of electrical pick-ups already on the market. There are several variations of the radio amplification which the skilled experimenter may adapt to meet his own views. There are complete kits ready for assembly by the inexperienced.

Anybody who has an old talking machine can make this conversion in less than fifteen minutes time—and he will have a musical device that is ready to perform amazingly at a moment's notice, and repeat to his heart's content.

As an adjunct and companion to the radio set, it is ideal. It will furnish enough volume to replace an orchestra for dancing and will give music that is hardly distinguishable from the real thing.

And when you take this new and interesting step, you may couple up first with the sound box in the old talking machine, then with any ordinary type of radio reproducer, and finally with one of the new exponential horns. Then play an old-type phonograph record and follow with one of the new-type electrically cut records. You'll be amazed.

Those of us who have been reluctant to put our old talking machines into the junk heap, hesitating, perhaps sentimentally, to charge off our investment; those of us who enjoy participating at least in the creation and building of something new and worth while; all those of us who are radio and music fans have a grand new field in which to surprise both ourselves and friends.



HOW ONE DEVICE IS USED ON A PHONOGRAPH

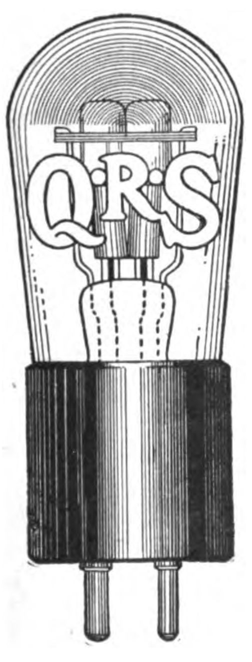
FIGURE 9: *The new Crosley electrical pick-up unit rests on a special base that contains a volume control. A universal joint and an extension arm allow the pick-up unit to swing freely in the groove as the record rotates.*

Your "B" Battery Eliminator will give you better service with

Q·R·S

(Trade Mark Registered)

Gaseous Rectifier Tubes



60 Milliamperes	-	**$4.50**
85 Milliamperes	-	**4.50**
400 Milliamperes	-	**7.00**

Ask for Catalog of full line of Standard Tubes.

Guaranteed

The standing of the Q·R·S Company, manufacturers of quality merchandise for over a quarter of a century, establishes your safety.

Orders placed by the leading Eliminator Manufacturers for this season's delivery, approximating Four Million Dollars' worth of Q·R·S Rectifier Tubes, establishes the approval of Radio Engineers. Ask any good dealer.

THE Q·R·S MUSIC COMPANY

Manufacturers

Executive Offices: 306 S. Wabash Ave., Chicago

Factories: Chicago—New York—San Francisco—Toronto, Canada—Sydney, Australia—Utrecht, Holland

Established 1900. References—Dun, Bradstreet, or any bank anywhere

Townsend
"B" Socket Power
"Best in World!"
Says A. W. GALE
of Gloversville, N. Y.

COMPLETE

Only $6.85
$1.00 Down
Balance C.O.D.

Below is a reproduction of Mr. Gale's letter of May 8th, 1927.

48 W. Fulton St.,
Gloversville, N. Y.

"Received the Townsend all O. K. *It is the best in the World and that is saying some.* I have a Radiola 4 tube. Get more stations than ever before. Some of them are CFCF, CKNC, WGY, KDKA, WGZ, WIP, WWJ, KTHS, KOP, KOA, WHAS, WTAM and KSD—besides 4 in Chicago, all in the East and then some."
A. W. Gale.

Replaces "B" Batteries

The letter above speaks for itself—proves beyond doubt that the Townsend "B" Socket Power is the most remarkable value in Radio today. Sam E. Fry of 1415 Holmes St., Kansas City, Mo., writes: "Eliminator works fine. Showed it to a friend and he wants one also. I will say it sure beats batteries. I get stations I never got before on a 6 tube set." Charles Ellis, 88 Jones Ave., Columbus, Ohio, says, "Your Eliminator is working fine. Have had station WJAX and others over 1,000 miles distant. Picked up 22 different stations one evening and around 30 another time. My neighbor has a $27.50 Eliminator and I don't see that it works any better than yours."

Delivers up to 100 volts on any set, on D. C. or A. C.—any cycle. Full tone, clarity and volume.

Tested and approved by America's leading Radio authorities—Radio News and Popular Radio Laboratories

ORDER TODAY!

Simply fill out the coupon and slip it into an envelope with only $1.00 and mail at once. Your Townsend "B" Socket Power Unit will be sent promptly. Deposit only $5.85 plus postage with the postman. Try out for 10 days—then if not delighted with improvement in reception, return it to us and purchase price will be refunded.

TOWNSEND LABORATORIES
713 Townsend St., Dept. 19, Chicago, Ill.

Attach Only $1.00 to this Coupon!
SEND TODAY

10 Days FREE TRIAL You are the Judge!

TOWNSEND LABORATORIES
713 Townsend St.
Dept. 19, Chicago, Ill.

Gentlemen: Attached find $1.00. Kindly send at once Townsend "B" Socket Power Unit, C. O. D., for $5.85, plus postage, on guaranteed 10-day free trial.

Name..

Address..

City.......................... *State*..............

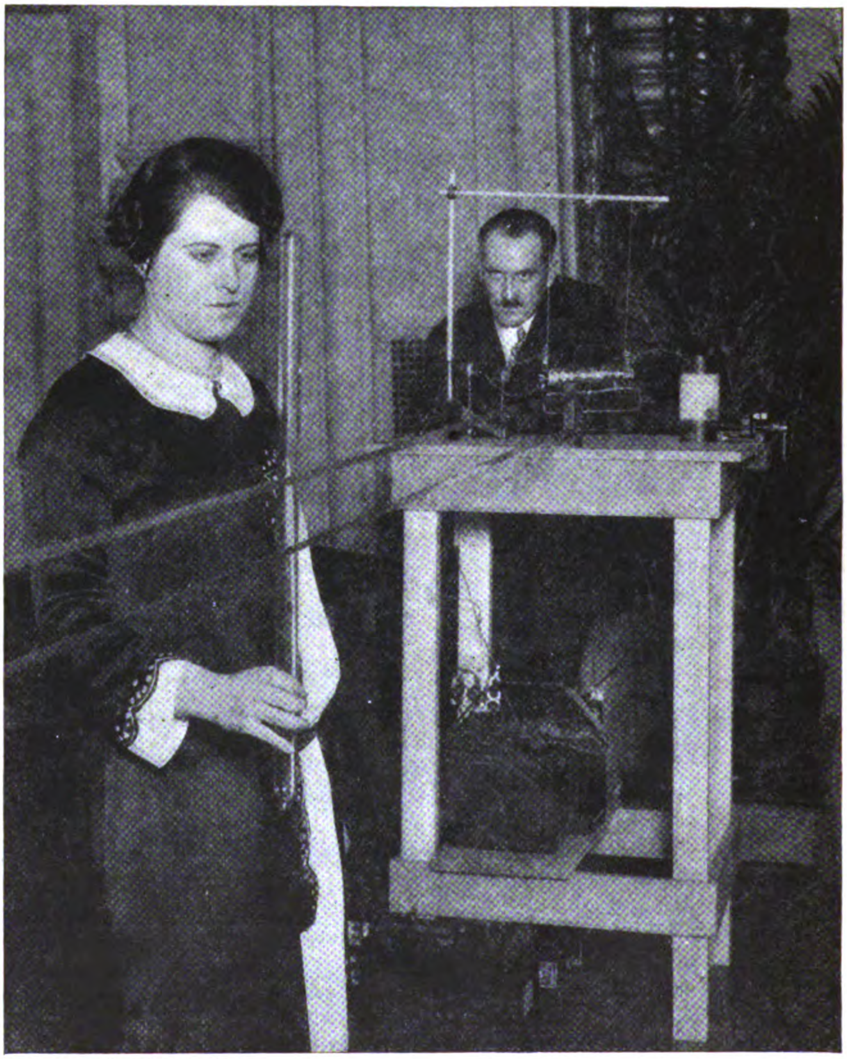
The New Prospects of Transmitting Power by Radio

(*Continued from page 13*)

meters, or 240 centimeters, in wavelength and with a power output of 35 watts or a little more. These waves he demonstrated to the Society; showing the creation of sharply-marked nodes of current and voltage on the familiar Lecher wires, displaying the possibility of lighting lamps in the empty air by the energy pick-up of short straight-wire antennas, and so on.

A wavelength of 240 centimeters, while extremely short in comparison with even the shortest waves used in broadcasting, is still too long for the beam work which Dr. Thomas foresees. To make beams of radio waves as completely concentrated and parallel as the light-beam of a searchlight one must proceed just as the searchlight makers do. The waves must be condensed and rendered parallel by a lens or by a curved mirror or both. The most convenient way to do this with radio waves would be by means of a metallic mirror, but that mirror must be at least as large, in diameter, as the length of one complete wave. For the 240-centimeter wave, therefore, a mirror necessary to make even a reasonably good parallel beam would have to be some eight feet across. The so-called "beam wireless," now in use by the Marconi interests between England and the Dominions, works on a somewhat different principle and does not produce the narrow beams or pencils of radio waves which Dr. Thomas has in mind.

A copper mirror eight feet in diameter is not out of the question. It would be



New York Electrical Society

Atoms Help to Demonstrate Power by Radio

In his New York City experimental talk on power by radio, Dr. Phillips Thomas indicated the very short wavelength employed by feeding the waves into a pair of horizontal aluminum ribbons, operating as Lecher wires. Nodes were then found by lamps or other indicators and the wavelength measured. In the background is Dr. Thomas, with the oscillator used to generate the waves; his assistant holds close to the ribbons a long glass vacuum tube containing a very little neon gas. When opposite points of high voltage along the Lecher ribbons, the neon atoms in this tube glowed brilliantly by induced electrification.

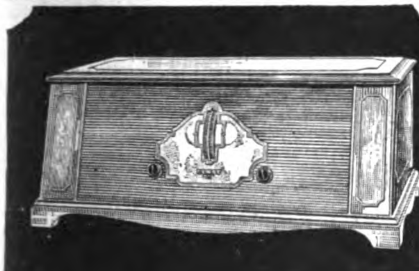
SANGAMO
MICA CONDENSERS
UNAFFECTED
by
MOISTURE

When the humidity hovers around 100, the components of your radio receiver are subjected to the equivalent of a water bath!

You can make certain, at least, that the fixed condensers in the circuit will not alter in capacity or efficiency under these conditions.

Use Sangamo Mica Condensers—they are permanently protected from *all* atmospheric action by a solid sheathing of pure bakelite!

SANGAMO ∴ ELECTRIC ∴ COMPANY
SPRINGFIELD, ILLINOIS
6336-3



See, Hear, The New
ELKAY
TRADE MARK REG.
ELECTRIC SENIOR
(No Batteries)
ELKAY SENIOR
(Six Tubes)
ELKAY JUNIOR
(Six and Seven Tubes)

JOBBERS
DEALERS
Write for territorial rights
The Langbein-Kaufman Radio Co.
Dept. P, 62 Franklin St., New Haven, Conn.

possible, therefore, to make parallel beams of these 240-centimeter waves, as Senatore Marconi did with slightly longer waves two or three years ago. But these would be neither narrow enough nor (with present transmitters) powerful enough for the spectacular results which Dr. Thomas believes possible. For these the wavelength must be shorter and the power larger. With the ten-centimeter waves which Dr. Thomas predicted as an illustration of radio beams, a four-inch copper mirror would be sufficient to produce a parallel beam quite of searchlight character. This, plus the increase of power output to the ten kilowatts which Dr. Thomas mentioned, is all that stands between us and the actuality of beams of radio power.

How difficult these actualities will be to realize no one can predict. The problem consists, as Dr. Thomas made clear, in devising new oscillating circuits which will operate at the enormous frequencies necessary—a wavelength of ten centimeters means a frequency of 3,000,000 kilocycles or three billion complete oscillations a second—and which will produce large power outputs at these enormous frequencies. No such oscillator is now known, but that should discourage no one. Only a few years ago a wavelength of one hundred meters was considered unreachable, except experimentally and with very low power. Today there is broadcasting as low as forty meters and three or four meters is quite easily attainable.

Assuming that it will be found possible to produce, in some manner, powerful wave discharges at frequencies in the neighborhood of the three-million-kilocycle mark, the production of the directed rays of radio waves will be quite simple. Their effect on the air must remain unknown until we have the beam to experiment with, but there is good theoretical reason to believe that they would ionize a fraction of the air atoms and make the path of the beam more or less conducting for ordinary electric currents, just as Dr. Thomas has assumed. His predictions stand as very reasonable possibilities—which is all that he implied that they were.

There is already material enough in the subject of radio power for some new Jules Verne to create another Captain Nemo and launch him on a romance about the world as it will be when Dr. Thomas' aerial radio beams actually do aid our contractors and bridge our rivers and cross our skies to feed the power antennas of our private houses. It would be far less wide a step from the present to that day than was the step which Jules Verne actually did take when he conceived Captain Nemo's wonderful submarine. Perhaps the beams of radio power will be attained no less quickly and no less completely.

Here's Work that's almost Romance!

Learn RADIO for BIGGER PAY!

J. E. Smith
President

Jobs paying $50 and all the way up to $200 a week are waiting for the Radio-trained man. Get into the new, growing Radio profession if you want to earn more money, have bigger opportunities for the future. I will train you **at home in your spare time.** Previous experience not needed—you learn quickly in a simple, clear, unforgettable way. Grade school education, or even less, is enough to start.

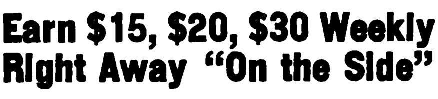
Earn $15, $20, $30 Weekly Right Away "On the Side"

You learn it all **by doing.** So practical is the training you get that almost from the time you start you can put your new knowledge to use. Little Radio jobs, I'll show you how to do in your spare hours, can bring you as much as $15, $20, $30 extra cash, weekly, after you get well started. This Radio training of mine is the one that's world-famous as the "Course That Pays for Itself." Many of my students put aside enough extra cash to start their own Radio business on graduation—all earned by this spare-time Radio work done while they are learning.

64-Page Book Sent FREE

Free—a 64-page book that tells you all about the bigger opportunities in Radio—the big money to be earned—how I'll prepare you thoroughly and completely in the quiet of your own home to enter any one of the twenty some odd lines of the Radio profession. Book tells all about my ways of helping you earn extra spare-time cash almost from the day you start with me. **Gives all information** about the six big outfits of Radio material I send you to experiment with: you can build more than 100 Radio circuits with these outfits, yet there's no extra charge for them. Everything—all services and material—included in one tuition fee (and you'll find it's surprisingly low, and can be paid in very small monthly amounts). Get the proof for yourself. Radio needs you—learn right now what it has to offer you. No obligation for the book—it's sent free—just mail the coupon today.

***Address:* J. E. SMITH, President**
National Radio Institute
Washington, D.C.



C O U P O N

J. E. SMITH, President,
National Radio Institute,
Dept. H-86, Washington, D. C.

Dear Mr. Smith: Kindly send me your free 64-page book with all information about learning Radio for bigger pay. I understand this places me under no obligation.

Name..

Address...

Town.................................. State.............

LYNCH RESISTORS

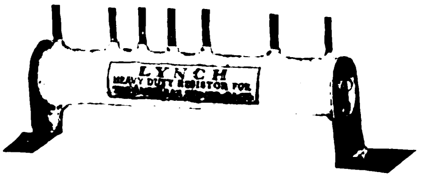
An EASY way to improve the TONE of your radio set —out of all proportion to the cost
LYNCH
resistance-coupled amplifier KIT $9.00
High Mu Tubes

The *Complete* Resistance Line

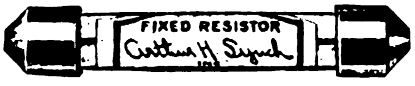
is a result of the focusing of the efforts of an organization, trained in the development and production of quality resistors, to the problem of supplying every resistance need of the manufacturer, engineer and radio fan.

This line includes every type of resistor required for receiving, transmitting and power supply work.

The stock sizes of Lynch Resistors have been carefully selected to meet the ordinary requirements of the average circuits. Special resistors of any desired sizes or characteristics can be had to order.



Tapped heavy duty type resistor for power amplifiers and battery eliminator circuits such as the Mayolian 171 and 210, the AmerTran and Silver Power Packs, and Thordarson 171 and 210. Price of AmerTran Tapped Resistor illustrated—$8.50.



Metallized resistors give continuous, conductive, non-arcing, noiseless and permanent resistance. They are available in sizes ranging from .25 to 10 megohms at 50 cents each; .012 to .2 megohm at 75 cents each; and .0005 to .01 megohm at $1.00 each.

Type "P" heavy duty resistors, wire-wound on porcelain, are conservatively rated at 20 watts carrying capacity and are designed for power circuits where the use of high voltages make ordinary resistors impractical. The stock sizes range from 2,000 to 100,000 ohms at from $1.25 to $4.00 according to resistance values.

The Lynch Resistance Line also includes: Type "C" heavy duty metallized resistors; Filament Equalizers; Grid Suppressors; Type "G" heavy duty resistors, wire-wound on glass; the Resistance-coupled amplifier kit illustrated; Single and Double Leak-Proof mountings.

Folder giving complete specifications and prices sent on request.

ARTHUR H. LYNCH, INC.
General Motors Building
1775 Broadway, at 57th St., New York, N.Y.

The New "Exponential Horn"

(*Continued from page 24*)

below which and above which tones are not emitted.

For example, some loudspeakers will reproduce no tone below one hundred vibrations a second. These are said to have a low-frequency cut-off of one hundred cycles.

It is sometimes said that the advantage of a horn for a loudspeaker involves the question of resonance. This resonance really amounts to distortion. If the horn resonates to any specific frequency or group of frequencies, this means that the horn is exaggerating these particular frequencies, while producing a relative depression in the intensities of other frequencies. If the music or speech being discharged by the diaphragm itself is already distorted this additional distortion by resonance in the horn may actually improve the final result, provided, of course, that the exaggerations of the horn apply to those particular frequencies which the diaphragm is emitting in less than proper intensity. Even in this case, the procedure is a poor makeshift. It is better to discharge from the receiver and from the diaphragm exactly the frequencies desired and then to see to it that these frequencies come through the horn.

In freedom from distortion the exponential horns are quite satisfactory, but it is possible to avoid distortion with other types of loudspeaker also. The same is true of the matter of cut-off. The lowest frequency which a horn will emit, which determines its low-frequency cut-off, is not fixed by the exponential principle, but merely by the length and width of the horn and by similar characteristics. Either an exponential horn or a cone loudspeaker or some non-exponential variety of horn can be designed to have a low and favorable cut-off, emitting frequencies down to fifty or sixty cycles or even lower.

It is the third factor, that of loudness, which brings the exponential horn its greatest victories. With a relatively small amount of energy emitted from the diaphragm itself, the cone of air, expanding as the horn enlarges in accordance with the exponential principle, transmits an exceptionally large fraction of this diaphragm energy to the outer air. If the exact dimensions of the horn provide the desirable low cut-off and if the details of design are adjusted to minimize distortion, it is possible to obtain great volume, which means loudness, without interfering with the absence of distortion which is so necessary for first-class musical reproduction.

To what extent, if any, the exponential horns are destined to replace the cone loudspeakers which now hold public favor, it is certain that the exponential principle will find important utility in all those varieties of radio reception where loudness is an essential; for example, where large audiences are being entertained or where music is to be provided for marching or for dancing.

A New Kink for Keeping Your Log-Book

(*Continued from page 53*)

are only ten kilocycles apart, even though their wavelengths are ten meters apart. At the same time WORD and KLZ are 60 kilocycles apart, though they also are only ten meters apart in wavelength. The ability of a receiver to separate two stations is a factor of kilocycle frequency difference instead of meters wavelength difference. Do not blame the set because it will not separate WOW and KYW, even though it does separate WSWS and WREO, and the wavelength difference is the same in each case.

One point which must be watched when making out the chart is probable inaccuracies in the call book data. Very few tabulations are entirely accurate; the errors often consist in giving the wrong kilocycle reading for a certain wavelength. This will throw the chart out of sequence, as kilocycles are the primary chart factor. Another type of error lies in showing an incorrect wavelength for a given station. If a wrong kilocycle reading is given, it may show up as the listing is being done, for the wavelength reading will be out of sequence. If a wrong wavelength reading is given, the operator will find it out when he gets the dial readings for the station, for they will then be out of sequence.

It is best to put down only the stations on which you are *sure* the data is correct, if you are keeping the chart in ink. It may be better to keep the data in pencil, if it can be protected from smearing, for nowadays the stations are hopping from wavelength to wavelength, changing call letters, appearing and disappearing at a rate that makes it possible for any record to be quickly out of date.

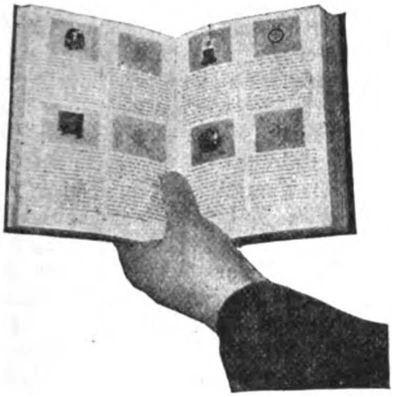
This chart is, however, well worth the time which may be put on it, because it forms an accurate guide to tuning, because of its clear relationship between wavelength and frequency, and because of its neatness as a record of stations that have been received.

TWENTY OF THE WORLD'S GREATEST RADIO SCIENTISTS WROTE A SINGLE BOOK

AND POPULAR RADIO CALLED IT

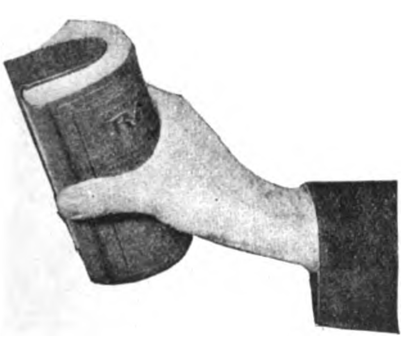
"EVERYMAN'S GUIDE TO RADIO"

Contributed to by the world's leading radio scientists, without question, the most comprehensive, most interesting and absorbing, and the most complete radio book yet published in any country. It is impossible to give comparisons, because comparisons do not exist. One must read Marconi on the subject of "beam transmission"; the late Charles Steinmetz on "Waves"; Sir Oliver Lodge on Coils, or Ambrose Fleming on "Vacuum Tubes," before the significance of these writings of the masters of the art can be fully appreciated.



1300 Illustrations!

"Everyman's Guide to Radio" contains 1300 beautifully engraved illustrations in 1200 pages of text.



Flexible!

These four books represent the latest practice in the art of book manufacture. Perfectly flexible, without damage to pages or binding.

Convenient!

A lot of information in a small space. Just the right size for the pocket and light in weight.

640 PAGES OF INSTRUCTIVE READING

For the "Broadcatcher" as Well as the Experienced Radio Enthusiast

This book of 640 pages, size 5¼" x7½", containing more than 1300 finely engraved illustrations, has been prepared by some of the greatest physicists and engineers of radio. "Everyman's Guide to Radio" stands as the first successful effort to meet the needs of all those who aspire to attainments in the science, whether they are "broadcatchers," skilled service men or students. This vast wealth of information represents studied compilation that has extended over two whole years and includes every phase of radio communication that can have any interest to those desiring meaty information.

QUICK ANSWER TO EVERY RADIO PROBLEM

Intelligent use of "Everyman's Guide to Radio" gives quick, understandable answers to practically every radio problem regardless of the technical accomplishment of the reader. Special emphasis has been laid on the illustrations contained in the "Guide." Hundreds of specially prepared drawings and photographs answer most radio problems at a mere glance. No effort or expense has been spared to make the "Guide" of maximum value to radio listeners. It is the fascinating story of radio in pictures and it is the most complete collection of instructive radio photographs ever published.

A BOOK YOU WILL BE PROUD TO OWN

It may be said without reserve, that "Everyman's Guide to Radio" is the most artistic and practical book ever published in the radio field. It contains over 640 pages printed on heavy calendered paper in legible type, making for the comfort and convenience of the reader. The covers are beautifully embossed and bound in Art Fabrikoid, better than leather, flexible, making the books conveniently portable.

CONDENSED TABLE OF CONTENTS

Part 1
- The First Principles of Radio
- The Electricity of Radio
- The Easy Principles of Diagram Reading
- How Waves Are Generated
- Mechanics of Tuning
- Detection and the Secret of Vacuum Tubes

Part 2
- Audio Frequency Amplification
- Radio Frequency Amplification
- Variable Condensers
- Coils—How to Use Them
- Improvement of Broadcast Reception

Part 3
- How to Make Radio Improvements
- Learning the Language of Dots and Dashes
- Batteries and Battery Chargers
- Different Types of Radio Receivers

Part 4
- Accessories and Radio
- Wonders of Radio Transmission

POPULAR RADIO, 627 West 43rd St., New York

EXAMINE THE VOLUME WITHOUT OBLIGATION TO BUY

So sure are the publishers of "Everyman's Guide to Radio" that this volume is just what everyone needs to complete his reference library and so sure are they that it is the most practical, complete and beautiful radio book yet published that they are willing to mail it to those interested for examination without obligation to buy. Just fill out the attached coupon and mail. The book will be mailed immediately. Upon arrival, you pay the postman $4.00 plus postage. Examine the book for 5 days. If, after that time, you are not convinced of the value to you, return in good condition and your money will be refunded, at once and in full, without question.

$ 4.00

POPULAR RADIO, Inc.,
627 West 43rd Street,
New York, N. Y.

Gentlemen:

Send me "Everyman's Guide to Radio" in one volume. I agree to pay the postman $4.00, plus postage. If, after carefully examining the book for a period of five days, I do not like it I will have the privilege of returning it to you and my money, in full, will be immediately returned.

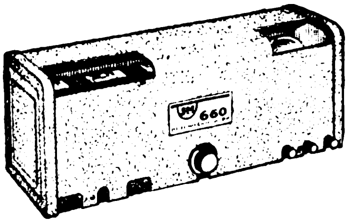
Name..

Address..

City........................State............

SM

UNIPAC
for Power



The Silver-Marshall laboratories now offer a series of power packs absolutely without comparison. Type 660-210 Unipac, a push-pull amplifier using two UX-210 tubes, will deliver from 100 to 300 times more power than a 201-A tube, or from 4 to 17 times more power than average 210 power packs. Type 660-171 Unipac, with two 171 tubes will deliver equal or greater power than average 210 packs at far lower cost!

There is a Unipac for every need, from the most powerful receiving amplifier ever developed down to a lower power 171 power pack. There are models for phonograph amplification, turning any old phonograph in a new electric type actually superior to commercial models costing from five hundred to several thousand dollars. And every Unipac, operating entirely from the light socket, supplies receiver "B" voltage as well.

Predominant!

S-M 220 Audio Transformers are absolutely the finest audio amplifying devices that the market affords. That's why you'll find them selected for the season's most prominent designs—that's why you'll see them in the studio amplifiers of such stations as WEBH, WCFL, WBBM, WCAE, WTAQ, KGDJ, WLBF and countless others. That's why you will eventually use 220's—for there's nothing finer. Price $8.00 each.

The 220 Audio Transformer with a turn ratio of 3:1 has the highest primary impedance of any known transformer. This value—the criterion of low note amplification—is 19,000 ohms at 30 cycles and 626,000 ohms at 1,000 cycles, approximately.

SILVER-MARSHALL, Inc.
844 WEST JACKSON BLVD.
CHICAGO, U. S. A.

In the World's Laboratories

(Continued from page 63)

tion, some of which have been taken up recently by Professor Donald A. Laird, of the Department of Psychology of Colgate University.[*]

It is proposed to test the consumption of energy and the output of work by average workers under noisy conditions and under quiet ones. The results, when Professor Laird has completed and tested them, can scarcely fail to be of interest to the radio professions.

Radio Waves to Make New Chemistry Possible

ALTHOUGH some of the most spectacular features of the New York Electrical Society's program on "Power by Radio," presented by two Westinghouse engineers on April 20, 1927, were the short-wave demonstrations of Dr. Phillips Thomas, which Mr. Elway describes elsewhere in this issue of POPULAR RADIO, equally significant indications of future progress lay in the remarks of Dr. Harvey C. Rentschler, accompanying his demonstration of the high-frequency, high-vacuum furnace. The availability of this new physical and chemical tool is apt to make it possible, Dr. Rentschler believes, to explore a field of chemical reactions never before accessible to man.

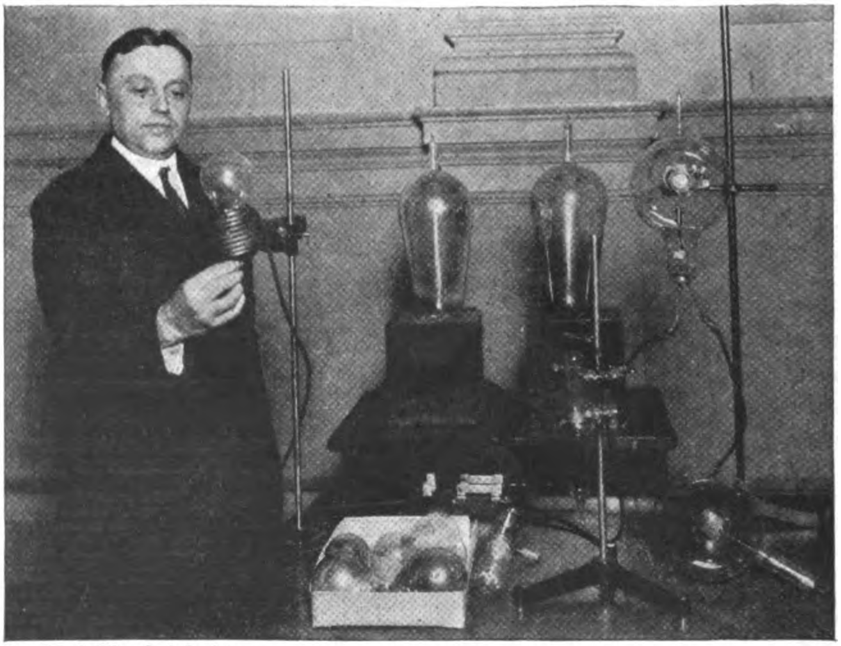
The possibility of using high-frequency electromagnetic waves, essentially similar to those used in radio, as carriers of heat energy and to attain high temperatures without contact with flames or with electric arcs, has already been discussed in POPULAR RADIO.[*] Oscillations generated by any variety of electric oscillator are run through a coil so placed that the electromagnetic field produced is absorbed more or less completely by some conducting object. Eddy currents produced in this object generate the heat. In Dr. Rentschler's arrangement of the apparatus either a mercury spark-gap feeding a transformer may be used as the source of energy, or a vacuum-tube oscillator may be employed. In either case the "radio power" thus generated is allowed to enter a vacuum, where it reacts with and heats the material on which the operation is to be carried out.

One practical accomplishment already realized is the production of thorium and uranium in solid metallic form, so that wires, rods or other objects may be made of these metals. As Dr. Rentschler demonstrated to the New York Electrical Society in a series of spectacular experiments, these remarkable metals have so great an affinity for the oxygen of the air, as well as for other gases, that it is virtually impossible to keep the metals from taking fire and burning up like tinder if they are heated in the air.

---

[*] "Tests Show Effect of Noise on Nerves," by Emily C. Davis. *Science News-Letter* (Washington, D. C.), volume 11, pages 221, 227-228 (April 9, 1927).

[*] "Melting Metals by Radio," by E. F. Northrup. POPULAR RADIO for May, 1924, pages 430-437.



New York Electrical Society

A PROPHET OF CHEMISTRY BY RADIO HEAT

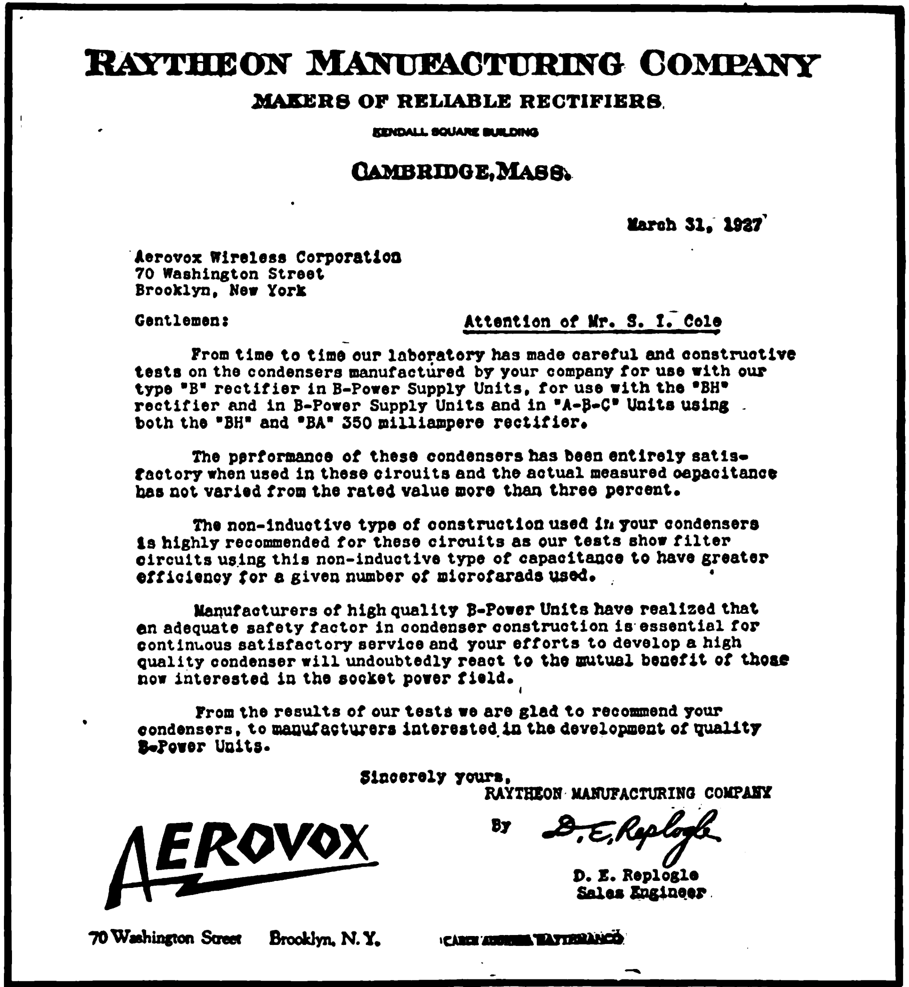
In demonstrating his high-frequency, high-vacuum furnace to the New York Electrical Society, Dr. Harvey C. Rentschler, Director of Research of the Westinghouse Lamp Company, predicted that new chemical reactions not possible in ordinary laboratories will be possible by the application of radio-generated heat inside a vacuum. A whole new field of chemical research is opened. Dr. Rentschler is holding a small vacuum bulb containing chemicals which will react when the radio power is turned on. In the background are the two mercury spark-gaps of the generator.

It is possible to prepare the metals by the reduction of their compounds with various chemicals. This yields powdered metal. Theoretically, this powder then can be fused into a solid lump, to be handled as other metals are. There is, however, the grave practical difficulty of inflammability. So soon as the powdered thorium or uranium is heated, even by the flame of a match or with an electric spark, it takes fire almost as though it were gunpowder. Many samples of uranium powder have thus gone off accidentally, Dr. Rentschler said, while attempts were being made to reduce the material to more solid and less inflammable forms.

This is the kind of problem for which the radio furnace is especially suitable. The inflammable metallic powder is packed into a crucible made of the difficultly fusible oxide of thorium called thoria. Crucible and powder are then placed inside the vacuum bulb of the radio furnace and subjected to the field generated by the oscillations in the coil of wire surrounding the crucible. The heat generated inside the metallic powder promptly melts this to a coherent metallic button. Since the melting takes place in a vacuum, with no oxygen present for the metal to combine with, no loss by burning occurs. The coherent metal, whether of thorium or uranium, possesses so much less surface in proportion to its mass that it does not burn in air, but remains reasonably unaffected. Wire, plates, rods and other forms have been made from both of the metals and are expected to find important uses.

There are many chemical possibilities, Dr. Rentschler went on to say, which have never been well explored because the reactions concerned require both heat and vacuum. Sometimes the vacuum is necessary because the presence of air, inescapable in ordinary laboratory operations, prevents or alters some feature of the reaction as it does in the heating of powdered thorium or uranium. In other instances the vacuum is necessary because some product of the reaction is to be set free in the form of vapor, which may be possible only at reduced pressure.

It is probable that most of the chemical reactions possible at ordinary pressures and in the open air have been examined, superficially at least, in the thousands of chemical laboratories now in operation all over the world. But that does not exhaust the possibilities of chemistry. Dr. Rentschler demonstrated to the Society several chemical reactions impossible under these ordinary conditions but which occur readily in the vacuum furnace. One of these was the production of pure metallic potassium, in the form of a vapor which condensed instantly to a brilliant mirror on the inside of the vacuum bulb in which the reacting materials had been placed.


RAYTHEON MANUFACTURING COMPANY
MAKERS OF RELIABLE RECTIFIERS
KENDALL SQUARE BUILDING
CAMBRIDGE, MASS.

March 31, 1927

Aerovox Wireless Corporation
70 Washington Street
Brooklyn, New York

Gentlemen: Attention of Mr. S. I. Cole

From time to time our laboratory has made careful and constructive tests on the condensers manufactured by your company for use with our type "B" rectifier in B-Power Supply Units, for use with the "BH" rectifier and in B-Power Supply Units and in "A-B-C" Units using both the "BH" and "BA" 350 milliampere rectifier.

The performance of these condensers has been entirely satisfactory when used in these circuits and the actual measured capacitance has not varied from the rated value more than three percent.

The non-inductive type of construction used in your condensers is highly recommended for these circuits as our tests show filter circuits using this non-inductive type of capacitance to have greater efficiency for a given number of microfarads used.

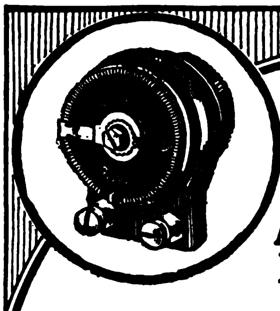
Manufacturers of high quality B-Power Units have realized that an adequate safety factor in condenser construction is essential for continuous satisfactory service and your efforts to develop a high quality condenser will undoubtedly react to the mutual benefit of those now interested in the socket power field.

From the results of our tests we are glad to recommend your condensers, to manufacturers interested in the development of quality B-Power Units.

Sincerely yours,
RAYTHEON MANUFACTURING COMPANY
By D. E. Replogle
D. E. Replogle
Sales Engineer

AEROVOX

70 Washington Street Brooklyn, N. Y. [illegible]


Exclusively Licensed by Technidyne Corporation under U. S. Patent 1593658.

Their Accuracy Endures

ROYALTY VARIABLE HIGH RESISTANCES

Wherever a high resistance is required insist on Electrad Royalty. These resistances control volume and tone with remarkable accuracy for the life of the set—indefinitely.

A range for every purpose—11 in all. Type E $2.00. All other types $1.50.

Write for free hook-up circular

At your dealers

175 Varick Street, Dept. 59
New York, N. Y.

ELECTRAD INC.

Now you can build the kind of a radio you have always wanted

This **BOOK TELLS HOW**

No matter whether you want to improve a set you now have or build a new one – ***get this book first.*** **Tells how to build the latest one, two and three dial receivers – 5 to 7 tubes.**

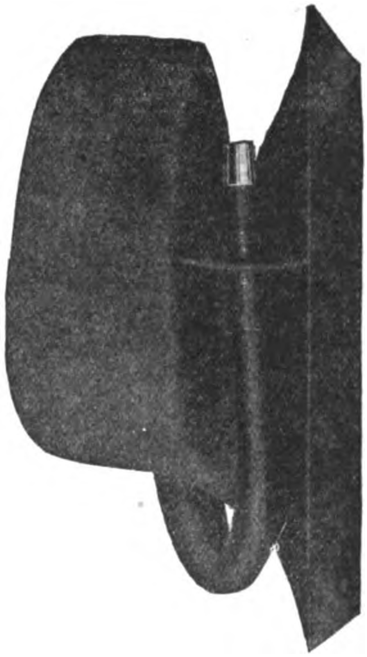
10¢ PREPAID

GEARHART-SCHLUETER, *Fresno, Cal.*

THE BIG WONDER

RACON
EXPONENTIAL
Sound Chambers
for
TRUE ORTHOPHONIC REPRODUCTION
(Mfd. under U. S. Pat. 1501032 and 1507711)

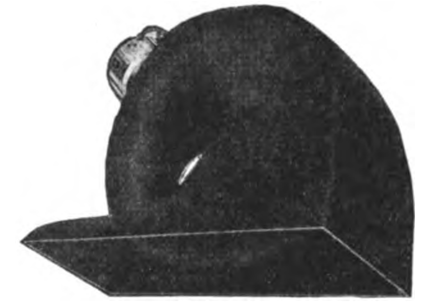
Every RACON Horn is acoustically correct in design and faithfulness of reproduction, regardless of SIZE. Every RACON Horn is made along lines conforming to the latest EXPONENTIAL theory of design.



Type OB 1315
Air Column, 104 inches
Bell 18" x 24"; Depth 13"

The RACON Process assures *uniformity; strength; maximum quality;* minimum weight.

THE LITTLE WONDER



Type OB No. 317
Air Column, 60 inches
Bell 6" x 15"; Depth 10½"

For further details address

RACON ELECTRIC COMPANY, Inc.
18-24 Washington Pl., New York, N. Y.

The Coil's the thing that makes Radio

NO RADIO UNIT IS ANY BETTER THAN ITS COIL

The performance of Battery Eliminators, Audio Transformers, Loud Speakers, and all other Radio Units is in exact ratio to the efficiency of their windings. **It's the Coil that does the work!**

Nearly all leaders in radio and radio parts use Dudlo Coils because they know their superiority.

DUDLO

Dudlo Manufacturing Corporation
FORT WAYNE, INDIANA

Are You Planning to Use the New Alternating Current Tubes?

Those who are planning to build new A. C. receivers or convert their old receivers by the use of A. C. tubes will do well to follow the activities of the POPULAR RADIO Laboratory. Our Laboratory experts are now planning and building full A. C. receivers of every type and this work will begin with this issue of POPULAR RADIO and will be described in full detail in the forthcoming issues. These new numbers of POPULAR RADIO will make radio history and those who are not subscribers will be wise to place a standing order with their news-dealer for a copy of POPULAR RADIO.

Of course, it is always better to subscribe at $3.00 a year and be SURE of receiving your copy.

Subscription Dept.

POPULAR RADIO, Inc.
627 West 43rd Street, New York, N. Y.

Noises From Northern Lights

MANY observers in northern latitudes have reported from time to time that they not only could see the aurora borealis but could hear it, as the heavenly display is accompanied by clear hissing or crackling sounds, not merely in the earphones of a radio receiver but in the open air.

As the electric discharge which is believed to constitute the aurora is known to occur some one hundred or two hundred miles up in the air, this report of the noisiness of the display has seldom been taken seriously by the scientists. It seemed impossible that any noise which might be produced in the upper air could reach as far downward.

As has happened in so many other instances, it now turns out that the theoretical scientists were wrong and that the actual observers were right. A scientist of distinction, long experienced in auroral observations and whose word will be taken without question by his peers, has heard the sound of the aurora for himself. This fortunate observer is Professor Hans S. Jelstrup, of the Norwegian Geographical Survey, at Oslo. On the evening of October 15, 1926, while engaged in astronomical observations on a hilltop near Oslo, Professor Jelstrup and his assistant noticed a "faint whistling sound, distinctly undulatory, which seemed to follow exactly the vibrations of the aurora."*

It is still unthinkable that any sounds from the actual aurora should be carried through the air from the enormous heights at which these discharges occur. Furthermore, that hypothesis would be inconsistent with the observation of Professor Jelstrup that the sounds heard by him undulated in intensity in agreement with the variations of the aurora. The explanation which Professor Jelstrup suggests and which seems likely to be the true one, is that the electric discharges of the aurora cause induced electric charges on the eaves of houses, the branches of trees and other objects on the surface of the ground. A multitude of small sparks, escaping from these objects, can then be blamed for the hissing noises.

Recent newspaper dispatches from Switzerland announced that the fire department of a town in that country turned out one evening recently because of a glare of aurora in the sky which someone mistook for a fire. Now that the aurora has been proved to be noisy as well as brilliant, it is in order for some town to report that the aurora turned out the firemen by making them think that they heard the fire whistle.

---

* "The Aurora of October 15, 1926, in Norway and Sounds Associated With It," by Hans S. Jelstrup. *Nature* (London), volume 119, page 45 (January 8, 1927). There is a report of the same occurrence, presented by Professor Jelstrup to the French Academy of Sciences, through General Ferrie, in *Comptes Rendus de l'Académie des Sciences* (Paris), volume 189, pages 159-160 (January 17, 1927).

This photograph shows the marvelous Bridge Tube Tester in use in POPULAR RADIO Laboratory. No other instrument known provides such accurate or convenient means for charting tube characteristics. Only tubes successfully passing this and other severe tests may be advertised in POPULAR RADIO.

How to Buy Vacuum Tubes with Safety

IT is obvious that no radio receiver can be better than its vacuum tubes, for it is in its vacuum tubes that the vital processes of detection and amplification take place. Here quality is gained or lost and sensitivity becomes a fact or a mere fancy.

If one could accurately visualize the delicate action taking place within the void spaces of this master device, one might have more respect for it and certainly more caution in making his future purchases, for vacuum tubes, unlike collar buttons or toothpicks, require at least an intelligent understanding of their great importance.

The POPULAR RADIO Laboratory, fully aware of its obligation to its readers in assisting them to purchase vacuum tubes wisely and with the absence of doubt as to performance, is using in its tube testing work, apparatus of the most modern character. It is a matter of minutes for the POPULAR RADIO engineers to read the complete pedigree of a vacuum tube; its amplification constant, plate impedance, mutual conductance, space current and plate voltage are almost instantly discernable with the Special Bridge Tester. This highly specialized method of examination is applied to the products of all tube manufacturers, and only those successfully passing these tests may use the columns of POPULAR RADIO.

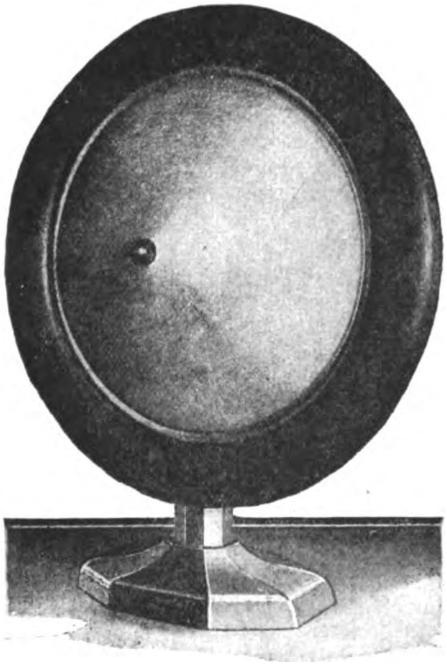
Such constant vigilance on the part of the Laboratory permits the reader to purchase vacuum tubes advertised in the columns of POPULAR RADIO with the comfortable feeling that the article is fully worth the price paid for it and that, used under the proper conditions, it will render satisfying service.

[A list of approved vacuum tubes will be supplied to those sending a self-addressed envelope.]

POPULAR RADIO, INC.

627 West 43rd Street

New York, N. Y.



Model A. C. 20
Height, including base, 21¾ in.

Far ahead of to-day's accepted standards—the new Amplion Cone with M.A.1 type unit

In quality of reproduction it sets a new high mark for others to strive for

THIS remarkable reproducer has an unusually wide musical range due to the striking developments embodied in the new Cone Unit.

One important feature of this unit is the *felt-lined stylus protection bar* which serves a double purpose. First, it protects the stylus itself against any possible injury. The felt lining, or stylus anchor, neutralizes the harmonics of the stylus itself.

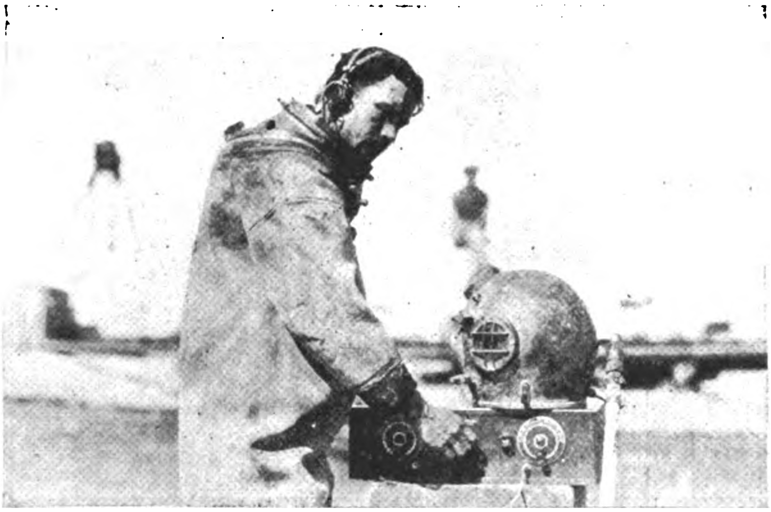
This model employs a new principle in Cone construction—a 14" cone being mounted on an 18" sound board which extends toward the center in back of the cone to form a resonating chamber. The unit, cone and sound board are assembled on a rigid bronze bracket with a handsome bronze base.

The sound board is finished in dark walnut, which, with the gold-finished cone in the center, gives this instrument both graceful beauty and dignity.

Write to us for price list and literature illustrating and describing the new Amplion line.

THE AMPLION CORPORATION
OF AMERICA
280 Madison Ave., New York City
The Amplion Corporation
of Canada Ltd., Toronto

AMPLION



ONE OF THE WORLD'S MOST INDEFATIGABLE FANS
Not content with listening in at home, Harry L. Paige, a deep-sea diver of Corpus Christi, Texas, takes his radio receiver to work with him. He installs it on the float, attaches a fifty-foot extension cord to his headphones, tunes in—and descends beneath the waves of Corpus Christi Bay, bringing the ether waves down with him. He reports that he gets good reception.

BROADCAST LISTENER

Comments on radio programs, methods and technique —from the point of view of the average fan

By RAYMOND FRANCIS YATES

Do Radio Fans Tune In on Lectures?

A CONTEMPORARY of ours recently raised the question, "Is radio educational?"

Whether it was his aim to instigate a controversy that he might stimulate interest in his writings or whether he was genuinely desirous of putting the question to a vote, is best known to himself. Be that as it may, the matter will bear some thought. We have, since the first wheeze of KDKA stimulated the fancy of the editor of the *Pittsburgh Post,* been strongly suspicious that radio pictured in the rôle of a college professor was a large and mushy piece of hokum.

That the average American broadcasting station offers some facilities for academic self-improvement cannot be denied, but does the broadcast listener want to take advantage of those facilities? That is just the point. He cares not a tinker's dam about them. No one understands this more than our broadcasters, and nothing proves it more conclusively then the evening programs of our studios. Mark the number of lectures. What is the ratio of educational lectures to music? It's small, and it is getting smaller. No studio manager is so dense that he cannot sense the waning interest in "educational programs"—meaning, in this case, lectures. People buy radios to be entertained, and the average listener jumps a station with a lecturer as quickly as he would drop a hot soldering copper.

Forcing an educational program of this type is suicidal to a broadcasting station. A ten-minute check-up on radio circulation will prove that; WJZ tried it, WEAF tried it. Although their material was excellent, bearing the stamp of Columbia and New York Universities, both the programs were flops and the stations, although by no means deserving it, lost listeners during these periods.

The public simply does not want to be educated by college professors. If it did, all our studios would be moved to the lecture rooms of our universities and sedate professors of English and rhetoric would replace the present crop of smart announcers.

The public made radio what it is today and many moons are going to pass before it changes it.

* *

Mr. Vorhees Shows the Way

THERE has come to the air recently over WJZ's wave a brand of popular music that is ravenously captivating both in orchestration and rendition. This delicious stuff is put out by "Don Vorhees and his Earl Carroll Vanities Orchestra," as the announcer says it.

Vorhees has got the knack of making the most banal trash enormously acceptable. His formula seems to be that of washing the face of the old stuff in such a delightfully entertaining way that it eludes identification and leaves the listener with the impression that he has listened to an entirely new creation, or, if not a new creation, at least one almost wholly transformed. Not once have we heard Mr. Vorhees' orchestra play a conventional bar, and the marvelous ingenuity he displays in making his selections is refreshing. For several months we have made it a point to be in his audience at 7.30 each Saturday night and not once has he lugged out one of the battered numbers that have descended to the level of radio habits.

Where Vorhees put his hand on this stuff we do not know, but the fact remains that, unlike so many other of our popular musical freshies, he always appears with unusual numbers dressed up in a new and enjoyable way.

* *

A Novel Stunt

ALTHOUGH it bore the tag of a successful manufacturer of automatic hot-heaters from the hinterlands of Pennsylvania, the recent effort of WJZ to familiarize the "radioatti" with the musical monkey-shine of the Broadway shows was certainly a brilliant attempt to escape the conventional air practice. It was an imaginative and rather ingeniously managed tour of the New York playhouses and the best music of each was broadcast.

Once more somebody did some thinking beyond "Songs of Yesterday" and the big idea of an hour of negro spirituals with white talent from the First Baptist Church.

* *

What Ether Waves Do to Save Good Voices

THE radio did very badly with Marion Talley's voice during a recent Victor Hour. Either that or Miss Marion did very badly with her own voice. At times it sounded frightfully nasal and at other times it possessed all of the delicate qualities of music from a "sweet potato."

Of course, we should like to believe that the young lady's voice does not microphone well—an entirely reasonable theory. In singing one familiar song she reminded us, by contrast alone, of the beautiful way in which Caroline Andrews of the Capitol sings it.

It is known that the microphone treats some voices very badly and flatters others. The radio should not be taken as the final criterion in judging a singer's voice. But with the growing popularity of broadcast entertainment the "radio voice" is becoming almost as important as the "auditorium voice." And it does seem that the broadcasts wherein our *prima donnas* make a very bad score greatly outnumber those in which they justify their high and mighty position in the "highbrow" realms of music.

$75 A WEEK BUILDING RADIO SETS

—in your spare time

JOIN the Radio Association of America. Learn how to build and repair radio sets. The Association will train you—start you out in business if you wish. Be the radio "doctor" of your community. $3 an hour upwards easily made. Radio offers you a big money-making opportunity right now.

Earns $500 in Spare Hours

"I have at last found myself," writes Lyle Follick, Lansing, Michigan. "I have already made over $500 building radio sets after working hours." Werner Eichler, Rochester, N. Y., writes, "I have made over $50 a week in my spare time."

Our members are starting radio stores, increasing their salaries, securing better positions, earning big money for the most enjoyable kind of spare-time work.

What a Membership Means

A membership in the Radio Association of America gives you the most up-to-date and thorough training in the Science of Radio.

You're taught how to build and repair all kinds of sets. You receive the privilege of buying parts at wholesale prices.

You're helped to make money.

Join the Association Now

If you're interested in Radio for either pleasure or profit, join the Association without delay, because we have a plan whereby your membership may not—need not—cost you a cent. Only a limited number of these memberships are acceptable. Write now for details. Write before it's too late.

This Association has prepared a beautiful book that gives figure-facts regarding the profit possibilities of the Radio Industry, the purpose of the Association, and the details of the Special Membership Plan.

Mail This Coupon

RADIO ASSOCIATION OF AMERICA
Dept. PR-8—4513 Ravenswood Ave., Chicago
Send me your book and details of your Special Membership Plan.

Name..
Address..
City............................State...........

Heavy Duty Wire Wound Rheostats—Potentiometers

Designed especially for heavy current control. Impossible to break down under high temperatures. No fiber to warp or to burn out. All parts riveted or spot-welded together. Limiting factor is the fusion point of the Nichrome or Advance Wire used. These units dissipate over 50 watts at 482 degrees Fahrenheit. Diameter—2 inches, single hole mounting.

500 ohm Centralab Power Rheostat **$1.25**
150 ohm Centralab Power Potentiometer **1.50**

At your dealer's, or mailed direct.

Central Radio Laboratories
17 Keefe Avenue Milwaukee, Wis.

Centralab

Write quick FOR HARRY ALTER'S *New Wholesale* RADIO BOOK

"Minute-Man" shipping service means quicker turnover for radio dealers — bigger business and more profits without increasing your capital investment.

Everything in RADIO at BED-ROCK PRICES

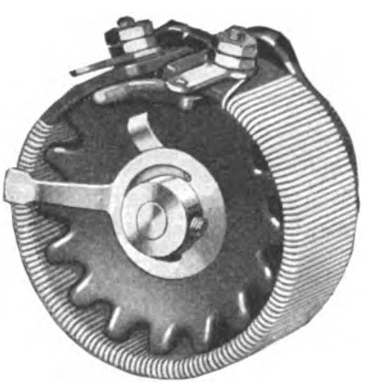
made possible by cash buying and cash selling. If it is used in radio and is a reputable product, we have it. Send now for catalog.

Note: We sell radio retailers only

The Harry Alter Co.

1734 Michigan Avenue CHICAGO

FROST-RADIO



FROST-RADIO

De Luxe 400-Ohm Resistance Unit Specified for Amertran Power Pack

THE new Frost-Radio De Luxe 400-ohm Resistance Unit, with windings on genuine Bakelite resistance strip, has been specified for the Amertran Power Pack. This unit gives wonderfully smooth control, and has less than half the resistance per turn of any other on the market. Air-cooled type, with Bakelite pointer knob. Order from your dealer today for your new Amertran Power Pack. Ask for No. 1824, 400-ohm Frost-Radio Resistance Unit.
List: $1.25

HERBERT H. FROST, Inc.
Main Offices and Factory
ELKHART, IND.

Chicago | Washington, D. C.
New York | Pittsburgh
Boston | New Orleans
Philadelphia | St. Paul
Los Angeles | Buenos Aires

CARTER

AS USUAL

is ready for the latest developments in the industry

The New

R. C. A.

Cunningham

and other

A. C. Operated Tubes

Rheostats, Potentiometers, Adjustable Resistors (semi-variable)

Ask your dealer

In Canada: Carter Radio Co., Ltd., Toronto

MEMBER RMA

Carter Radio Co.
CHICAGO

The Flood of Sentimental Songs

THE reminiscent program filled with the goofy sentimental songs of another day is, for the present at least, aces high with the program engineers who prescribe the broadcasting diet.

The epidemic of "old favorites" has been raging as it never raged before, and rarely does an evening pass that the wearied searcher for meaty entertainment is not called upon to share in the revival of ditties that, in days past, were A No. 1 ammunition for whiskey tenors in the maudlin stages of the old-fashioned Saturday night bat. These dolorous memories of the nineties might be immensely popular if used in homeopathic doses, but daily application is a bit too much to relish without objection. Heaven knows the average song is goofy enough without making any sustained effort to select the most sentimental ones! It's all very pretty and very sweet and very Bertha-M-Claylike to be implored by an announcer shedding onion tears to turn back the tattered, yellow pages of memory scented with withered roses—but, after all, it's banal stuff. It shows as few other things show what a powerful small amount of creative thought is being put into programs by those responsible for their acceptance.

Sentimental slush may have been sure fire once, but unless we're shooting wide of the mark, it compares very, very favorably with the popularity of bedtime stories at the present writing.

* *

Real Humor on the Air

WHILE the fact remains that the radio is sorely in need of something substantially and potently more humorous than the wise-cracking of studio sheiks, the situation has found some relief during the past few months by the constant appearance of such capable comedians as the Record Boys (WJZ) and Sam and Henry at WGN. We wish especially to commend the Record Boys, Sammy Stept, Frank Kamplain and Al Bernard, for they have, to our way of listening, succeeded with a brand of negro dialogue that is nothing short of outrageously funny. Since their first appearance we have been leaving the dinner table at the salad for fear of missing a single line of their chatter.

Dialogue well done may be worked up into a type of humor that is very acceptable on the radio, and we have yet to find better and more conspicuously entertaining masters of it than the Record Boys. One may laugh heartily at their puns without feeling ashamed for having permitted them to slip by one's guard.

We have yet to catch these fellows uttering a studied word or a line that is not deliciously spontaneous and delightfully humorous.

POPULAR RADIO DEALER AND JOBBER LISTS AVAILABLE TO MANUFACTURERS

The Service Bureau of POPULAR RADIO is able to place at the disposal of radio manufacturers a list of over 21,000 radio dealers, 3,926 radio manufacturers, 1,746 jobbers and 326 manufacturers' representatives. These addresses are immediately available for circularizing prospects for new Fall lines, and more detailed information and rates will be gladly supplied to those who wish to take advantage of what is without doubt one of the most carefully kept lists at present offered for use.

Address all inquiries to:

Service Bureau
POPULAR RADIO, Inc.
627 West 43rd Street
New York, N. Y.

A Plea for Fewer "Announcements"

WJZ, now the potential nucleus of a great national chain, has restored a practice which, to our mind, marks it as something in the way of a novice in the matter of presenting its program to the listener.

Instead of minimizing the work of its announcers, instead of making the announcer what he should be, a mere necessity, it attempts to glorify him and to make of him a positive luxury. Indeed, WJZ has originated the perfectly preposterous practice of having one announcer introduce the next, just as though announcers needed to be introduced. On one occasion the sanguine Mr. Cross announced the always audacious Mr. Sherris, and Mr. Sherris, graciously informing the audience that it was listening to WJZ, announced further that Mr. So-and-So would administrate next. And this all in the bare space of a minute or less!

Some day, perhaps, WJZ will learn that the great American radio audience, leaving out the frantic old maids, the high-school mush-note writers and the lady whose husband does not understand her, wants entertainment on the hoof and that it is not especially interested in anything that announcers have to offer aside from good articulation and perhaps just enough sense to know when the time has come to stop talking.

* *

A Unique Stunt

IN their effort to transcend what have become the commonplaces of the air, a few of our broadcasters are resorting to devices that, appraised by their intrinsic value as producers of entertainment, make the commonplaces ripe with divertissement.

One of the most annoying of these new practices is that of asking the listeners to imagine they are this or that or that they are here or there.

If you are not asked to imagine that you are in an airplane or attending the coronation of Henry the VIII, you are called upon to listen to impossible stories that go to make up the continuity of the weekly program of some catsup manufacturer.

The exploits of Don Amaizo are cited as a good 12-pound example. In this program the millions of listeners in the second largest chain are presented with instalments of a romantic piece of claptrap that would not hold the attention of a nitwit. Not only the substance but the method of reading those episodes of the dashing Don Amazio remind us, for all the world, of the first time that we were exposed to the "Wizard of Oz" through the condescension of our school teacher in the third grade.

If our broadcasters must resort to the imaginative assistance of the listeners, let them do it on rare occasions and let them do it more adroitly. Only once during the past six months have we managed to tap a program wherein we were asked to "imagine" and where, contrary to what we had been educated to expect, the "attention value" ran away up to 78 degrees. The pick-up came from the Long Island studios of the Famous Players-Lasky Corporation. The audience was supposed to be eavesdropping on the making of a new Richard Dix picture. While the whole thing was a gross piece of advertising, it was so cleverly done that had Mr. Lasky come to the microphone at the end of the performance and asked us to subscribe to his stock he would have found us in a mood to forgive him. The whole atmosphere of the great Long Island Studios was available.

And Graham MacNamee did an exceptional piece of descriptive announcing.

* *

The Stupefying Hand of the Censor

EITHER a certain station is becoming stupidly chauvinistic or it timidly blue pencils anything that might not conform with the ⅜-inch moral gauge of the Methodist fathers.

When a certain politician of New York attempted a sensible, accurate eulogy of George Washington from that studio, a puritan censorship descended upon him and prevented him from saying anything that would destroy in the smallest extent the national hokum that has been piled sky-high around our first President. Washington has long since ceased to be a man. He's a legend—an impossible, pure-minded simp who never took a drink, never told a lie and never did a thing that would make of him anything more virile or strong than a sex-complexed weakling.

Yet XYZ believes that this is the picture that its audience wants. In defense of its position it offers up the excuse that it has a diversified audience "whose prejudices it must respect." Naturally, it ignores those of its listeners who want to appraise Washington as a man and not as an angelic dunce. Imagine, if you will, such a man suffering the mental and physical torture of Valley Forge or any of the great campaigns engineered by the Commander-in-Chief of the American Forces! The whole thing becomes preposterous.

If this idiotic blue-penciling of history is the index of the rigorous puritan censorship that might be expected to follow it, we can rest assured that radio, one of the finest scientific flowers of the human intelligence, is doomed to the hands of the bigots. What radio has to fear most is coming to pass, and that is its use as a medium for propaganda.

RADIO
PARTS—ACCESSORIES
AND SETS

Distributors Since 1919

WE MERCHANDISE THE FOLLOWING LINES:

All-American Radio Corp.
Allen-Bradley Co.
American Hard Rubber Co.
Amsco Products, Inc.
Balkite (Fansteel Prod. Co., Inc.)
Barkelew Elec. Mfg. Co.
Benjamin Electric Co.
Birnbach Radio Co.
Brach Manufacturing Co., L. S.
Carter Radio Company.
Central Radio Lab. (Centralab).
Crosley Radio Corp.
Daven Radio Corporation.
Deutschmann Company, Tobe.
Dubilier Condenser Corp.
Durham Co.
Eby Manufacturing Co., H. H.
Electrad, Inc.
Fahnestock Electric Co.
Fleron & Son, Inc., M. M.
Frost, Inc., Herbert H.
Gilbert Company, A. C.
Herald Electric Company.
Interstate Electric Co.
Jefferson Electric Mfg. Co.
Jewell Elec. Instrument Co.
Karas Electric Company.
Majestic (Grigsby-Grunow-Hinds Co.)
Martin Copeland Company.
Mueller Electric Mfg. Co.
National Carbon Company, Inc.
National Company, Inc.
Perrine Quality Products Corp.
Radio Engr. Laboratories (REL).
Radio Corp. of America.
Radiall Company (Amperites).
Remler (Gray & Danielson Mfg. Co.)
Samson Electric Company.
Signal Electric Mfg. Co.
Silver-Marshall, Inc.
Steinite Laboratories.
Sterling Manufacturing Co.
Thordarson Elec. Mfg. Co.
Weston Electrical Instr. Corp.
Yaxley Manufacturing Company.
And many others.

DEALERS: Send for Our 1927-1928 Large 400 Page Profusely Illustrated Catalog

F. D. Pitts Company
219-A Columbus Avenue
BOSTON, MASS., U. S. A.

Complete A. C. Operation a Practical Reality

For the past several seasons the trend has been toward complete battery elimination. Many satisfactory plate supply units operating from A. C. have been developed, but filament operation from an A. C. source has presented more of a problem due to the larger currents required and increased expense in the rectifier and filter circuit.

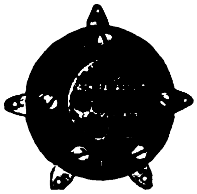
The newly announced A. C. tubes offer an excellent solution to this problem.

TYPE 440-A

TYPE 440-A LOW VOLTAGE TRANSFORMER

The Type 440-A Transformer supplies voltages for all popular A. C. tubes and sufficient current for all ordinary receiver requirements. The following voltages and currents are available: Pri. 115 V (for lines 105-125) 60 cycles.

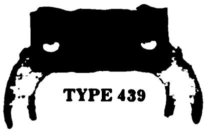
Sec. 2 volts....................8 amperes
3.5 volts....................2 amperes
5 volts....................2.5 amperes
7.5 volts....................2 amperes
Price....................$10.00


TYPE 438

TYPE 438 SOCKET

The new type UY-227 or CX-327 detector tube has a separate heating element and requires a socket designed to take the new five prong base.

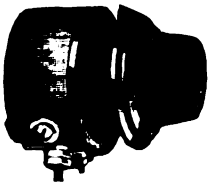
Type 438 Socket....................$0.50


TYPE 439

TYPE 439 RESISTANCE

The new A. C. tubes require a resistance with center-tap across the filament. The Type 439 resistance is adaptable to any type of socket.

Type 439 Center Tap Resistance.........$0.60


TYPE 410

TYPE 410 RHEOSTATS

The new A.C. tubes require low resistance rheostats capable of carrying ample current.

Resistance	Current	Price
.5 ohm	3.5 ampere	$1.25
1.5 ohm	2.0 ampere	1.25

Write for diagram showing how to adapt the filament wiring of the popular type of receiver to A. C. operation by use of General Radio parts especially designed for this purpose.

Your local dealer should have the necessary parts in stock.

If he is unable to supply you with all the items required, we shall be glad to send them to you prepaid upon receipt of list price.

GENERAL RADIO CO., Cambridge, Mass.

Nassau Power Radio

The Ultimate
in radio
Reproduction

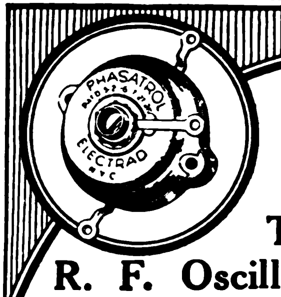
Your house current
operates it

NO { BATTERIES
CHARGERS
LIQUIDS
HUM

Nassau

Distributors write for territory

NASSAU RADIO CO.
60-A Court Street
Brooklyn, New York



Licensed by Rider Radio Corporation. Pats. Pend. Patented 5-2-'16. Patented 7-27-'26.

To Stop R. F. Oscillations:

"Phasatrols"

A true balancing device for Radio frequency amplifiers

Radio fans everywhere are preparing for perfect Summer reception. They are equipping their receivers with Phasatrols, the marvelous new Electrad invention which puts an end to squeals caused by radio frequency oscillation.

Booklet showing how to install Phasatrol free upon request. Send for your favorite circuit with Phasatrols.

Price - - $2.75

At your dealers, or write
Dept. 58, 175 Varick Street
New York, N. Y.

ELECTRAD INC.

A New Broadcaster That Knows How

WHEN WABC picked up its traps and moved from the quiet of Richmond Hill, Long Island, to a spiffy new studio within the range of a taxi's klaxon from Carnegie Hall, we inclined toward the opinion that here was "just another broadcaster" coming to town, with nothing more laudable up its sleeve than the prospect of soliciting the attention of concert singers and temporarily embarrassed instrumentalists who had previously balked at a subway excursion to the fringes of Brooklyn.

Subsequent developments have forced us to revise this opinion, and we are now willing to admit that WABC is one of a precious few studios that form the nucleus of polite broadcasting in these United States.

And WABC has something more substantial in its fibre than a thin veneer of good manners. The majority of its program features are tasty and polite and the work of its announcers is always well within the confines of decency and propriety.

WABC, among other things, has been careful to recognize the limits of broadcasting, as the following statement from its publicity department shows:

> "It is a well-known fact, which no doubt all broadcast listeners have discovered from their own experience, that large orchestras playing in large halls cannot be broadcast well at the present time. Problems of balance and volume, problems resulting from too much resonance, echoes and other extraneous noises make the broadcasting of large groups of instruments or singers exceedingly difficult. Results so far have been only mediocre, and it is therefore the belief of the Atlantic Broadcasting Corporation that for the present, at least until further progress is made in the art, that best results in the broadcasting of a large orchestra such as the New York Philharmonic can be secured by setting up ideal conditions in the studio and then utilizing a sufficient number of the master musicians of the orchestra to gain the necessary variety and color without bringing into the problem the so-far unsolved difficulties of excess volume. An excess volume is needless, causes blasting, and to the ear of the broadcast listener is far from pleasing."

Those who share the peculiar spell of the radio must agree that this is not the mere ravings of a publicity man; it is an engineering fact.

The feat of perfect transmission from such sources involves more than the planting of a microphone on a window-sill; and while we have listened to a few perfect examples of it, they come about as often as snow in June. If broadcasting ever descends to its soupiest reaches, it happens when an inexperienced broadcaster sallies forth to pick an outside event with a fifteen-dollar speech amplifier and a bundle of bell wire. Some of the best studios in the business have an extremely bad score, and yet, in the face of it, the thirty-five-dollar-a-week engineers of the washing-machine stations will tackle an outside job at the drop of the hat. All of which goes to show that broadcasting is still, except in precious few cases, in the hands of irresponsible youngsters.

* *

Good Manners in the Studio

SOME of our broadcasters are just beginning to realize that it is the little details just as much as the major gestures that go to make up the program that is in good taste.

Just as a miscue on the part of an actor or actress may destroy a dramatic performance, so might a sneeze or a carelessly spoken word in the studio tend to destroy a first-rate radio recital. It is indeed reassuring to find many of our Grade A studios insisting more and more upon proper conduct and the avoidance of those annoying little distractions that so quickly mar the texture of a program.

Mr. Frank McEnivy has sent on to us the code of studio conduct for performers as it is posted in KOA. That it has been thoughtfully worked out is evident:

> Programs start on the minute.
>
> Coughing, sneezing, clearing the throat, scraping the feet and other disturbances in the studios are annoying to listeners. The microphone is so sensitive that the slightest commotion may be transmitted to the unseen audience. Therefore, when the announcer calls, "Quiet, everybody!" kindly comply.
>
> Do not begin singing or playing until the announcer gives the signal.
>
> Unless you have memorized your music, be prepared with an extra copy, as you do not stand near the piano when singing.
>
> Do not be perturbed if the announcer motions for you to move nearer the microphone or withdraw while singing.
>
> Very loud singing or playing is objectionable, as it detracts from successful broadcasting, often producing a shattered effect. The best choral effects are obtained when each person sings in a subdued manner.
>
> To pianists: Too much loud pedal spoils the rendition. The top of the piano should be left down, as the best broadcasting is accomplished when the instrument is closed.

Although KOA has been alert in this matter of "studio manners," it has overlooked many offensive things that happen daily in some of our best regulated studio families. How annoying it is to have a performer carry on random conversation with the announcer within range of the microphone and how utterly maddening it is to have an exceedingly presumptuous performer address the listener. Not that we are a snooty listener or that we are so strait-laced that we cannot tolerate informality, but we do object to informality on the air when we know there is nothing back of it but a desire on the part of the performer to "crash" his audience.

The VIII Commandments

—for hot weather radio reception

I. Don't try for distance records in midsummer; tune in on nearby stations if you want enjoyable reception.

II. Don't expect perfect reception every night; summer is the time of thunderstorms.

III. Use a longer antenna, more tubes, higher plate voltage, a more sensitive antenna and tune more carefully if you want louder signals.

IV. Don't force your set to give overloud signals; a moderate amount of volume will cause less distortion and is more desirable in every way.

V. Use a smaller antenna or a wave-trap to get rid of a nearby station that drowns out all other reception.

VI. Tune in on the high-power stations for the best summertime reception.

VII. Tune your set carefully; many fans complain that their set is worthless when their operation is actually at fault.

VIII. Read POPULAR RADIO; it will help you to operate your set to the best advantage and keep you up to date in radio.

* *

One of a Listener's Privileges

RECENTLY an irate *pater-familias*, accompanied by his lawyer, invaded the sanctum of the Radio Supervisor of the Second District, to demand that one of the well-known New York stations be shut off the air because it had allowed a song to be rendered from its studio that was, in his opinion at least, unsuited for youthful ears.

"If you didn't want to have your children listen to it, why didn't you tune it out?" inquired the Supervisor.

"The kids wouldn't let me," replied the nettled parent.

"Well," responded the Supervisor, "I don't see how you can expect the Department of Commerce to tune it off in your home. Besides, the song you refer to has been sung on every vaudeville and music hall stage in all of the big cities and at private concerts in residences, many times. We haven't the power to act as censors of the air to the extent of shutting off anyone who happens to offend you. But that is your privilege. Don't hesitate to exercise it."

—RADIO GUIDE

* *

A Useless Loudspeaker

MR. NEWLYRICH (*proudly exhibiting latest purchase*): My dear, here's a little present for you—a French loudspeaker; isn't it a beauty?

MRS. NEWLYRICH: Whatever made you go and buy that thing, James, when you know that I can't understand a word of French?

—*Wireless Magazine*

Acme
ANTENNA
—with
Seven Strands
of enameled
Copper Wire

Best outdoor antenna you can buy. Seven strands of enameled copper wire. Presents maximum surface for reception, resists corrosion; this greatly improves the signal. Outside diameters equal to sizes 14 and 16. (We also offer solid and stranded bare, and stranded tinned antenna.)

Loop Antenna Wire
Sixty strands of No. 38 bare copper wire for flexibility, 5 strands of No. 36 phosphor bronze to prevent stretching. Green or brown silk covering; best loop wire possible to make.

Battery Cable
A rayon-covered cable of 5, 6, 7, 8 or 9 vari-colored Flexible Celatsite wires for connecting batteries or eliminator to set. Plainly tabbed; easy to connect. Gives set an orderly appearance.

Acme Celatsite Wire
Tinned copper bus bar hook-up wire with non-inflammable Celatsite insulation, in 9 beautiful colors. Strips easily, solders readily, won't crack at bends. Sizes 14, 16, 18, 19; 30 inch lengths.

Flexible Celatsite for sub-panel wiring
A cable of fine, tinned copper wires with non-inflammable Celatsite insulation. Ideal for sub-panel or point-to-point wiring. Strips easily, solders readily. Nine beautiful colors; *sold only in 25 ft. coils, in cartons colored to match contents.*

Spaghetti Tubing
Oil, moisture, acid proof; highly dielectric — used by leading engineers. Nine colors, for wire sizes 12 to 18; 30 inch lengths. (We also make tinned bus bar, round and square, in 2 and 2½ ft. lengths.)

Send for folder
THE ACME WIRE CO., Dept. P
New Haven, Conn.

ACME WIRE
MAKES BETTER RADIO

28 Leading Radio Engineers Specify
Hammarlund Products In Their Newest Receivers

HAMMARLUND MANUFACTURING COMPANY
424-438 W. 33rd Street, New York

Ask us for a list of the latest models of receivers for which Hammarlund Products are officially specified

For Better Radio
Hammarlund
PRECISION
PRODUCTS

Write for illustrated literature describing the world-famous Hammarlund Roberts "HiQ" Receiver.

Televocal
QUALITY TUBES

"Televocal" Typifies Highest Quality in Tubes — Manufactured by Technical Experts

IN ALL TYPES

If Televocal Tubes do not maintain the highest characteristics and specifications, after exhaustive and scientific laboratory tests, they do not leave our factory.

Dealers, Order Through Your Jobbers.

With our factory constantly operating, we can assure prompt deliveries right through the season.

Televocal Corp'n
Televocal Bldg. 588 12th Street,
WEST NEW YORK, N.J.

BROADCASTS

An Amateur Message That Met Itself Coming Back

AMATEUR radio has accomplished the hitherto impossible; it has actually performed a stunt in "less than no time." While operating an amateur receiver and transmitter one night, E. Granbacks, an operator of station 6CTX of Richmond, California, got in touch with an amateur station in Belgium with the call eb4WW. The Belgian gave Granbacks a message going to Hawaii, the time in Belgium being 4.45 A. M. Shortly after this Granbacks succeeded in hooking up with the desired amateur station in Hawaii, whose call was oh6AXW, and gave him the message. This occurred at 9.30 P. M., of the day before, in Hawaiian time. Thus a message actually traveled 7,500 miles and yet arrived at its destination seven and a half hours before it was filed in Belgium!

* *

The "Radio Rights" of Poets

POETS are beginning to realize that radio is opening up new avenues of revenue. In Sweden a bill has been recently introduced that provides the same protection to poets whose works are read in public—including radio broadcasting—that is accorded to dramatists, composers and others. The new bill aims to establish a system of royalty payments to poets whose work is read before the microphone.

* *

A Chance to Learn Radio Free

AN opportunity to learn about radio is one of the advantages offered to amateurs this summer by the U. S. Army. The chance to qualify as commercial operators, licensed by the Department of Commerce, is one of the practical features of the course, which will be conducted in connection with this year's Citizens' Military Training Camp at Fort Monmouth, N. J., a Signal Corps post. In addition to the regular Signal Corps course of instruction in the use of military radio, a special evening course has been authorized by General McRae for the Fort Monmouth camp. This course will offer instruction in advanced methods of commercial radio practice and at the conclusion of the camp those students who have qualified will be eligible to take the Department of Commerce examinations.

At the evening courses the students will be instructed by army radio experts, and arrangements have been made for the youths to conduct experimental work in the Signal Corps laboratories at the post.

* *

A "Musical Counsel" Enters the Realm of Radio

IN view of the emphasis which POPULAR RADIO has always laid upon the use of radio for instruction purposes in our schools and colleges, particular interest is attached to the recent announcement that Walter Damrosch, the eminent musician who recently retired as conductor of the New York Symphony Orchestra, has accepted the post of "Musical Counsel" for the National Broadcasting Company. In this newly created position Mr. Damrosch will officiate and advise in all matters relating to the higher musical activities and possibilities of the radio; he already has under way a gigantic plan for promoting fine music through the medium of radio broadcasting, a plan that provides for a series of concerts supplemented by talks which will reach the majority of the 25,000,000 students in American schools and colleges.

* *

A New Interference Rule

IT has been approximated roughly that the carrier wave of a 100-watt station may create interference over a distance of 100 miles, a 500-watt station over 500 miles, a 1,000-watt station over 1,000 miles, and a 5,000-watt station over 5,000 miles. Therefore, the deduction is that 5,000-watt stations should not be assigned to the same wavelength excepting when located on the Atlantic and Pacific coasts of the country. By the same process of reasoning, every station above 5,000 watts should be assigned an exclusive wavelength.

TOBE

Trade Mark Reg'd U. S. Pat. Office

B - BLOCK

No. 660

Specified for the

SILVER-MARSHALL UNIPAC

In value—in performance this new TOBE B BLOCK, 660, lives up to the reputation to which its name entitles it. Chosen by McMurdo Silver for his new UNIPAC, it plays its part in the fine results obtained from this carefully engineered power amplifier.

Price, $12.00

TOBE Condensers and B Blocks are found in all the leading radio units. Send for Pamphlet L-8.

Tobe Deutschmann Co.

Engineers and Manufacturers of Technical Apparatus

CAMBRIDGE, MASS.

MAGNAPHON

Electrical Record Reproducer

Price $12.50

Will make the old type phonograph or any of the small portables perform like the new Electrical Reproducing Machines costing from $350 to $1,000.

When static blankets the air—

When listening to a Radio Program is torture—

Buy a MAGNAPHON, place it on your old type phonograph or portable machine and broadcast your own music through the Radio Set.

The richness and tone range of the reproduction will prove really amazing.

The deep bass notes, the drum beats, the very high notes, will all issue forth with a life-like mellowness and brilliance.

EASILY INSTALLED

No adjustments—No removal of old sound box or fishing for correct angle is necessary. Just place the MAGNAPHON alongside the tone arm and insert the plug into the detector socket.

FROM YOUR DEALER OR US

If your dealer cannot supply you and will not get it for you, we will ship you direct on receipt of money order for $12.50.

TECTRON RADIO CORPORATION

1270 Broadway New York

Australia Listens In on Denver

BROADCASTING stations in many cities of Australia and New Zealand recently declared a local "silent night" while receiving sets tuned in on an all-Australian program broadcast from station KOA, in Denver, Col. The program had previously been arranged by short wave communication between Sidney and Denver, and included such novelties as ballads of the Bushmen and New Zealand jazz. A seven hours' difference in time made it necessary for Denver to start broadcasting at 12.55 A. M. in order that Australia might listen in before dinner.

* *

A "National Radio Audition"

A NATIONAL radio audition for the purpose of uncovering the best undiscovered voices in America is announced by the Atwater Kent Foundation. According to the present plan, every community in the country is to be given an opportunity to elect by popular vote the best voices among men and women; these entries will compete in state and sectional auditions to be broadcast by radio. After the weeding out in the sectional audition, five men and five women will be brought to New York for the finals. Substantial prizes are to be offered for both the state and national winners, and it is hoped that the experiment will uncover a great deal of real talent that would not have been discovered otherwise.

* *

Radio Helps the Flood Victims

INSTALLATION of a radio set at base headquarters of the American Red Cross in Memphis, Tenn., was one of the first moves made by the relief forces in caring for 350,000 refugees from the Mississippi flood area; this set hooked up with thirty stations in concentration camps throughout the seven flooded states and on boats operating for the Red Cross. The flood covered the largest area of any disaster in Red Cross history, and inasmuch as the usual means of communication had been disrupted by the rampant waters, radio played an heroic rôle. The station at Memphis was installed by the Navy Department, which dispatched an officer with ten sets to that city early in May; other important emergency stations were located at Helena, Pine Bluff and Eudora, Ark., and Vicksburg, Miss. The radio hookup was used to direct relief boats, to maintain communication between relief centers and to order supplies in emergencies. In some instances workers in camps cut off from supplies by the water actually "radioed" grocery lists to headquarters, greatly speeding up the process of procuring supplies.

QUALITY DONGAN PRODUCTS

Approved Power Supply Parts

An enthusiastic market demands sets powered from the light socket. Dongan, producing parts exclusively, offers to the set manufacturer power supply transformers and chokes designed for all electrically operated sets. Dongan Power Supply Parts represent the latest development in design and refinement in construction.

Receiver manufacturers can rely on Dongan as a source of supply on Power Supply Parts for all approved types, mounted or unmounted. Send your specifications to our engineering department. Samples available now.

Power Supply Transformers

used with 350-400 m.a. tubes. This transformer is constructed in a handsome, durable metal case.

$15 List

Power Supply Chokes

for 350-400 m.a. tubes. Two chokes built into one case.

$15 List

FANS— **Rebuild that old set. In the long run it will be an economy, and you'll have assurance of full-powered reception all the time—at a very low cost.**

If your dealer cannot supply you, immediate delivery will be made upon receipt of check or money order. Specify type of rectifier you intend to use.

DONGAN ELECTRIC MFG. CO.

2991-3001 Franklin St., Detroit, Michigan

TRANSFORMERS of MERIT for FIFTEEN YEARS

First in the Field Specializing in Cockaday Kits

S. HAMMER RADIO CO.
303 ATKINS AVE., BROOKLYN, N. Y.

Build your
BALSA-WOOD *Speaker*
from the
DURA-BALSA KIT

Complete Parts with Instructions

Price with Unit $14.00 | Price without Unit $8.00

NEW AMERTRAN POWER PACK

NEW A B C POWER PACK

NEW BATTERYLESS A C TUBE RECEIVER

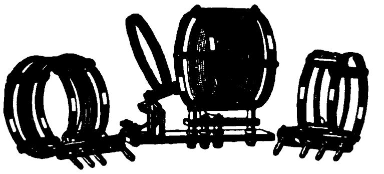
COCKADAY L C-27 BROADCAST RECEIVER

The Above Kits Can Also Be Obtained Completely Wired to Specifications.

Write for our interesting special circular which we have prepared on the LC-27 Receiver and above Kits.

DEALERS: WRITE FOR SPECIAL DISCOUNTS

The Famous Aero Short Wave Kit Now Improved!



AERO LOW WAVE TUNER KIT

Code No. L.W.T. 125..................Price $12.50

Always the prime favorite of all experts and amateurs insistent upon the very best in short wave of reception, the AERO Low Wave Tuner Kit for this season has been made even better than ever!

The Kit illustrated above is completely interchangeable. It includes 3 coils and base mounting, covering U. S. bands 20, 40 and 80 meters. You can increase or decrease the range of this short wave by securing the AERO Interchangeable Coils described below. All coils fit the same base and use the same condensers and the complete equipment covers a gapless range of 13 to 725 meters.

New AERO Interchangeable Coils

INT. No. 0..............................Price $4.00
Range 13 to 29.4 meters.

INT. No. 4..............................Price $4.00
Range 125 to 250 meters.

INT. No. 5..............................Price $4.00

Normal range 235 to 550 meters. However, by using .0001 Sangamo fixed across the rotor and stator of the .00014 variable condenser, the maximum wave band of this coil is increased to 725 meters.

Plan for D. X. Records Now!

Order any of these coils direct from us if your dealer doesn't happen to have them. Be sure to specify code numbers when ordering.

AERO PRODUCTS, INC.
Dept. 104 1772 Wilson Ave.
CHICAGO, ILLINOIS

Mormon Pictures Jesus as a User of Radio

THAT radio was understood and used by Jesus Christ and his missionaries, "as well as by Lucifer in his efforts to thwart the work of the Lord," is the extraordinary view expressed by Elder B. F. Grant, reported as a spokesman for the Mormon Church, in a recent talk broadcast from station KSL. The transmission of the human voice across the Atlantic Ocean daily by radio telephony is accomplished by the ingenuity of man, but "the science orginated with God," according to the elder's statement. "The power to transmit speech without wires has always been known to God," Elder Grant added.

* *

A Chess Game by Radio

WHAT is thought to be the first chess game ever played by radio in the Dominion of Canada was recently staged between the chess club of Dartmouth, Nova Scotia, and the club of St. Johns, Newfoundland, through the cooperation of amateur station IDD, operated by Major W. C. Borrett, of the former city, and station 8AR, owned and operated by Loyal Reid, of St. Johns.

The game was reported to be a success, and it is expected that the two amateur stations will be called upon to arrange another match.

* *

Holland Is Ready to Ring Us Up

THE Dutch telephone service is said to be getting ready to start trials of radio telephone communication with the United States by way of the New York-London circuit. The connection will be effected by land wires to Amsterdam, sea cable from Amsterdam to London, and the present radio telephone system from thence across the Atlantic.

* *

Plans for an Endowed "University of the Air"

WHEN Merlin H. Aylesworth, President of the National Broadcasting Company, recently told the Boston Chamber of Commerce that "broadcasting has thrown the door wide open to those who would raise the level of national culture by greater educational opportunities and to the millions who yearn for some of the advantages of higher education," he voiced an opinion that has been reiterated in POPULAR RADIO on many occasions during the past five years. That a practical plan will develop from this dream, is indicated by the announcement that "the task is now before the leading educators of our country to formulate a program of general education that would be in effect a national 'university of the air.'"

YOUR RADIO PROBLEMS SOLVED

POPULAR RADIO maintains for the benefit of its readers a Technical Service Bureau and Laboratory, which will, without charge, answer by personal letter any question or problem submitted by a subscriber.

In writing please confine your questions to one general subject, writing on one side of the paper only, and enclose a self-addressed and stamped envelope.

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently: look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c. a copy.

May, 1926
—How to Draw Up Your Own "Tuning Graphs."
—How to Build the Improved Raytheon Power-pack.
—How to Build an Antenna Mast for $15.00.
—Fifteen Ways to Reduce Static.
—Do Your Coils Broadcast?

June, 1926
—How to Build the New Home Receiver.
—How to Put Up a Good Outdoor Antenna.
—How to Get the Most Out of Your Ready-made Receiver.
—Audio-frequency Amplification. How to Get it Without Distortion.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.

July, 1926
—How to Get the Best Reception in Summer.
—The Best Crystal Set for $13.00.
—How to Build the Newest Portable "Town and Country" Receiver.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.
—How to Get the Most Out of Your S-C Receiver.

August, 1926
—A New Method of Using Harmonics for Determining Frequencies.
—POPULAR RADIO Circuits.
—How to Build the Improved Browning-Drake Receiver.
—How to Pick Out a Loudspeaker.
—How to Get the Most Out of Your "Town and Country" Receiver.
—Three Vacuum Tubes in One.

September, 1926
—Foretelling Radio Reception from the Weather Map.
—How to Build an Impedance-coupled Amplifier.
—A Radiant Crystal Pilot.
—POPULAR RADIO Circuits.
—How to Simplify Your Set with Automatic Filament Controls.
—Inside Information on New Radio Receivers.
—How to Wire Your House for Radio.

October, 1926
—How to Build the New LC-27 Receiver.
—The Radio Road Hog.
—POPULAR RADIO Circuits.
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits.
—How to Build the LC-Intermediate Power-pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC-Junior Power-pack.

February, 1927
—The Coming of the "RADIO UNIVERSITY."
—How to Get Quality Amplification.
—How to Build and Use a Portable Test-Board.
—How to Assemble the All-Amax Senior Three-tube Reflex Receiver.
—What's New in Radio.

March, 1927
—How to Build the Univalve Receiver.
—POPULAR RADIO Circuits.
—How to Increase the Range of Ammeters and Voltmeters.
—How to Build Your Own 36-Inch Cone Loudspeaker.
—What's New in Radio.

POPULAR RADIO
Dept. 48
627 W. 43d St., New York

SET BUILDERS

Write us before you build

BEFORE you build, get our prices on the parts you are planning to use.

We handle only brand new apparatus—standard makes that are fully guaranteed. QUANTITY sale of QUALITY parts explains our low prices. Compare with others and see why thousands of fans look to us as radio headquarters.

All the latest kits, accessories and parts — a million dollar radio stock to choose from.

CHICAGO SALVAGE STOCK STORE

Dept. PR 509 S. STATE STREET

CHICAGO, ILL.

The Watch Dog of Your Tube
F
F
TO "A" BATT.

Getting FULL Tube Value

PERFORMANCE and life is what you pay for in a tube. Amperite alone insures getting both. Controls filament current automatically. Simplifies wiring. Eliminates hand rheostats. Identify by the name. Accept nothing else.

FREE—The Radiall Book. Gives season's most popular Hook-Ups, and invaluable Construction Data. Send for it today to Dept. PR-8.

Radiall Co., 50 Franklin St., New York

Price $1.10
mounted (U.S.A.)
Sold Everywhere

AMPERITE
REG. U.S. PAT. OFF.
The "SELF-ADJUSTING" *Rheostat*

Transoceanic Calls Heard

POPULAR RADIO has just received a card from W. B. Jennings (NU-1ON), 26 Tapley Street, Lynn, Mass, thanking us for forwarding to him some calls heard (QSL) cards from station EF-8EZ in France.

POPULAR RADIO is doing this same service for all other American amateurs. Arrangements have also been completed for forwarding American QSL cards to their proper destinations in foreign countries. This delivery is made through local agents in those countries who have or can obtain the present address of foreign amateurs. American amateurs are invited to send their cards to foreign amateurs through this office, which will not only assure safe delivery through the special agencies which are thus provided, but which will publish a monthly list in a "Transoceanic Calls Heard" department.

Address your cards to the foreign amateurs by call numbers and enclose them in envelope to—

The Calls Heard Editor,
POPULAR RADIO,
627 West 43rd Street, New York.

THE following stations were received and logged at the amateur station of A. Cremailh (EF-8JZ), at 15, Rue de Vitre, Rennes, France, using a receiver with detector and one stage of low frequency:

NU-4RY—Feb. 20, 1927; signal strength R7; good rectified AC note on 37 meters; no fading;
NU-1KF—Feb. 20, 1927; signal strength R6; very fine DC note on 37 meters; no fading;
NU-3GW—March 6, 1927; signal strength R7-8; fine note on 36 meters; no fading;
NU-8DEI—March 6, 1927; signal strength R7; rectified AC note on 37 meters; no fading;
NU-1AAO—March 6, 1927; signal strength R9; rectified AC note on 36 meters; no fading;
NU-1MV—March 6, 1927; signal strength R6-7; rectified AC note on 37 meters; no fading;
NU-2CDR—Feb. 20, 1927; signal strength R6; good rectified AC note on 36 meters; no fading;
NU-3BTQ—March 6, 1927; signal strength R6-7; good rectified AC note on 37 meters; no fading;
NU-4XE—March 6, 1927; signal strength R9; splendid DC note on 39 meters;
NU-2OR—March 6, 1927; signal strength R6; DC note on 40 meters; no fading;
NU-2RS—March 6, 1927; signal strength R6; DC note on 40 meters; no fading;
NU-1ID—March 6, 1927; signal strength R7-8; good DC note on 36 meters;
NU-3BUV—March 6, 1927; signal strength R6; 37 meters;
NU-1BKP—Feb. 27, 1927; signal strength R6-7; rectified AC note on 36 meters;
NU-2BXU—March 8, 1927; signal strength R6; 41 meters; no fading;
NU-2AVW—Feb. 27, 1927; signal strength R6; good rectified AC note on 37 meters; no fading;
NU-1AIR—Feb. 27, 1927; signal strength R7; AC note on 36 meters; no fading;
NU-8AVD—Feb. 27, 1927; signal strength R8; very good rectified AC note on 36 meters; no fading;
NU-1AJX—Feb. 27, 1927; signal strength R7-8; good rectified AC note on 37 meters;
NU-3HG—March 3, 1927; signal strength R6; good rectified AC note on 37 meters;
NU-1RD—Feb. 13, 1927; signal strength R6-7; rectified AC note on 37 meters;
NU-8BRC—Feb. 13, 1927; signal strength

ASK . . . ANY . . . RADIO . . . ENGINEER

The "Mountie" isn't lonely any more

WHEN the supply ship steams south from the last outpost of civilization in September, not to return until the following July, loneliness will never again beset the lives of the Royal Canadian Mounted Police who patrol that vast, wild area.

Radio is now brightening the long winter nights with music, special programs, messages and greetings from their "home folks."

And in the receiving sets of the "Mounties" is the best equipment obtainable. The batteries they use *must* be dependable. They *must* serve until new supplies are brought in a year later.

Ask any Radio Engineer

BURGESS BATTERY COMPANY
GENERAL SALES OFFICE: CHICAGO
Canadian Factories and Offices:
Niagara Falls and Winnipeg

BURGESS
RADIO BATTERIES

NATIONAL
TONE FILTER

A Power-Tube Output Unit—as recommended for use by R.C.A. and other makers of power tubes and by loud-speaker manufacturers universally. Contains choke and large capacity condenser. Instantly connected to any Radio set without tools, 'phone cord being provided with each Tone Filter for this purpose. Protects speaker and improves tone.

Price complete with 5-foot cord.$7.00
Price without cord.............$6.50

A NEW
NATIONAL
B-POWER SUPPLY

A newly designed B-Eliminator, with special features not hitherto offered to the public, will be announced in the near future. The unit is small, light, simple and easy to set up. The price will be attractive.

The new NATIONAL B-POWER SUPPLY is manufactured under license association with Radio Corp. of America, General Electric Co., Westinghouse Electric & Manufacturing Co. and the American Telephone & Telegraph Co.

BE SURE YOU GET THE GENUINE
NATIONAL
RADIO PRODUCTS
NATIONAL CO., INC., W. A. READY, Pres.
MALDEN MASS.

R7-8; very good DC note on 37 meters;

NU-2OX—Feb. 13, 1927; signal strength R6; rectified AC note on 37 meters;

NU-2EAS—Feb. 13, 1927; signal strength R6; AC note on 37 meters;

NU-2NZ—Feb. 13, 1927; signal strength R7-8; rectified AC note on 38 meters.

NU-9CFM—Feb. 13, 1927; signal strength R5-6; fine DC note on 36 meters;

NU-1AXA—Feb. 13, 1927; signal strength R7; very good rectified AC note;

NU-2VK—Feb 13, 1927; signal strength R6-7; rectified AC note on 37 meters;

NU-7AA—Feb. 13, 1927; signal strength R6; very good rectified AC note;

NU-3QW—Feb. 13, 1927; signal strength R6; rectified AC note on 36 meters; no fading;

NU-2CYH—Feb. 13, 1927; signal strength R6-7; good DC note on 37 meters;

NU-4OB—Feb. 19, 1927; signal strength R6; AC note on 37 meters;

NU-3AUV—Feb. 19, 1927; signal strength R7; excellent DC note on 37 meters;

NU-4AK—Feb. 19, 1927; signal strength R7; rectified AC note on 37 meters;

NU-1BDH—Feb. 20, 1927; signal strength R4; rectified AC note on 43 meters;

NU-1BFX—Feb. 19, 1927; signal strength R7; rectified AC note on 37 meters;

NU-2CCD—Feb. 20, 1927; signal strength R6; rectified AC note on 40 meters;

NU-1IN—Feb. 20, 1927; signal strength R6-7; good DC note on 37 meters;

NU-6TK—Feb. 20, 1927; signal strength R7; rectified AC note on 36 meters;

NU-2TP—Feb. 20, 1927; signal strength R6-7; rectified AC note on 36 meters;

NU-3AFW—Feb. 20, 1927; signal strength R7; rectified AC note on 37 meters;

NU-1LC—Feb. 20, 1927; signal strength R7; rectified AC note on 37 meters;

NU-3TI—Feb. 20, 1927; signal strength R6; rectified AC note on 37 meters;

NU-8CYI—Feb. 20, 1927; signal strength R6; rectified AC note on 36 meters.

THE following stations were received and logged at the amateur station of R. Simon (EF-8IX), at 44, Rue Eugene Pelleton, Choisy-le-Roi (Seine), France, using a Schnell receiver with a detector and one stage of low frequency:

NU-2AOL—March 23, 1927; signal strength R6; rectified AC note on 20 meters; some fading;

NU-8NT—March 25, 1927; signal strength R5; DC note on 19.75 meters; slight fading;

NU-1ABZ—March 23, 1927; signal strength R4-7; rectified AC note on 21 meters; some fading;

NU-1RY—March 23, 1927; signal strength R7; DC note on 21 meters; slight fading;

NU-1ALR—March 5, 1927; signal strength R4; rectified AC note on 37 meters;

NU-3AUV—February 23, 1927; signal strength R7; fine DC note on 38.8 meters; no fading;

NU-4OB—March 5, 1927; signal strength R5; rectified AC note on 38 meters; some interference;

NU-8BAJ—March 13, 1927; signal strength R3-2; DC note on 39 meters;

NU-5JF—Feb. 18, 1927; signal strength R4; rectified AC note on 37 meters;

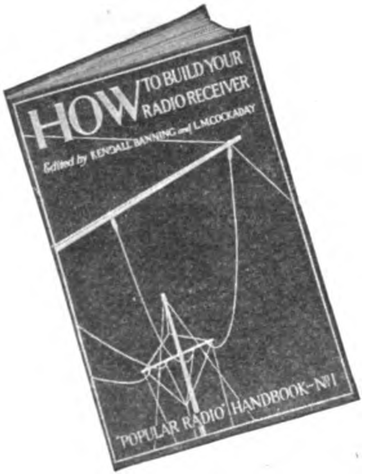
NU-8ACZ—March 14, 1927; signal strength R6; rectified AC note on 37 meters; some interference;

NU-3SJ—Dec. 1926; signal strength R3; rectified AC note on 40.5 meters; much interference; bad fading;

NU-1CJC—Feb. 6, 1927; signal strength R7-9; fine rectified AC note on 37.6 meters; bad interference;

NU-8DEI—March 6, 1927; signal strength R7; DC note on 39 meters; no fading;

FREE


HOW TO BUILD YOUR RADIO RECEIVER
Edited by KENDALL BANNING and L.M.COCKADAY
POPULAR RADIO HANDBOOK-No1

WITH
POPULAR RADIO

Aside from the feature of economy, there is the thrill and satisfaction that comes from building your own receiving set.

Thousands of sets have never been constructed because of the atmosphere of mystery that has enveloped the whole subject of radio. Kendall Banning, Editor, and Laurence M. Cockaday, Technical Editor of POPULAR RADIO, through their close contact with the great radio public, sensed this and compiled a book that will convince the veriest beginner that technical training is not essential. If you have a little time to devote to a most fascinating pastime, send for a copy of "How to Build Your Radio Receiver."

Free Advisory Service

POPULAR RADIO is full of helpful suggestions as well as instructive and entertaining articles on radio and allied scientific phenomena. This information is supplemented by an advisory service that is free to all subscribers. Any problem you encounter that is not answered in the book or magazine will be answered by personal letter if you will submit it to the Technical Service Bureau.

A Valuable Combination

For the next thirty days we will give you a copy of "How to Build Your Radio Receiver," FREE and enroll you for all privileges of the Technical Service Bureau at no further expense, on receipt of your remittance of $3.00 in payment for a 12 months' subscription for POPULAR RADIO. (As an alternative offer, if you wish the combination with POPULAR RADIO for 7 months only—send but $2.00). In any event, you run absolutely no risk, as we will refund in full if you are not more than satisfied with your purchase.

CONTENTS

In "How to Build Your Radio Receiver" you will find complete constructional diagrams, specifications, photographs and instructions for building the following sets. Each has been selected as representative of its circuit because in laboratory tests it proved the best for distance, selectivity, tone volume, simplicity of construction, ease in tuning, reliability and all-around satisfaction.

A $5 CRYSTAL SET
THE HAYNES SINGLE TUBE RECEIVER
A TWO-STAGE AUDIO-FREQUENCY AMPLIFIER
THE COCKADAY 4-CIRCUIT TUNER
A 5-TUBE TUNED RADIO-FREQUENCY RECEIVER
THE "IMPROVED" COCKADAY 4-CIRCUIT TUNER
THE REGENERATIVE SUPER-HETERODYNE RECEIVER

POPULAR RADIO
627 West 43d Street, N. Y. C.

Offer expires August 30, 1927

POPULAR RADIO, Dept. 45A,
627 West 43d St., New York City

Enclosed remittance of $3.00 is payment in full for a 12 months' subscription for POPULAR RADIO and copy of "How to Build Your Radio Receiver" FREE.

Name..

Address......................................

City.............................State...........

☐ Check here and remit $2.00 if you prefer POPULAR RADIO for 7 months only in combination with "How to Build Your Radio Receiver."

THE following stations were received and logged at the amateur station of J. M. Sacazes (F-8SM) at 18 Bard Natabair, Toulouse, France, using a low-loss tuner with one stage of low-frequency amplification:

U-2TP—Feb. 22, 1927; signal strength R7; no static; slight fading; bad interference;
U-1BHM—Feb. 22, 1927; signal strength R5; no interference; no fading;
NU-1BF—Feb. 27, 1927; signal strength R5; no atmospherics; bad interference; no fading;
NU-2ARY—March 1, 1927; signal strength R6; no static or interference; no fading;
NU-1ACH—March 1, 1927; signal strength R7; no static or interference; no fading;
NU-2BXU—Feb. 26, 1927; signal strength R6; no interference or static; no fading;
NU-3AFW—March 4, 1927; signal strength R7; no interference or static; no fading;
NU-3CKJ—March 12, 1927; signal strength R6; no interference or static; no fading;
NU-3AHL—Feb. 11, 1927; signal strength R8; good note; no fading;
NU-2APD—Feb. 12, 1927; signal strength R7-8; unsteady note; slight interference; no static;
NU-2CZR—March 12, 1927; signal strength R7; no interference; no fading;
NU-1AEN—March 3, 1927; signal strength R6-7; no static; bad interference;
NU-1AZA—March 6, 1927; signal strength R7; no interference or static; no fading;
NU-8AX—March 6, 1927; signal strength R6-7; bad atmospherics; no interference; no fading;
NU-1II—April 4, 1927; signal strength R8; no atmospherics; no fading.

THE following stations were received and logged at the amateur station of L. Berger (F-8OEO) at Villa Babiole, Cambo, Basses Pyrenees, France, with a cage antenna and counterpoise and one stage of low-frequency amplification:

NU-3GX—March 23, 1927; signal strength R3-4; rectified AC note on 41 meters; bad static; slight fading;
NU-2CUQ—March 24, 1927; signal strength R6-7; good DC note on 37 meters; some interference; no fading;
NU-4OY—March 31, 1927; signal strength R6-7; rectified AC note on 37 meters; no interference; bad static;
NU-1CPB—March 31, 1927; signal strength R7-8; rectified AC note on 37 meters; much static and interference; slight fading;
NU-8DJP—March 24, 1927; signal strength R7; fine DC note on 40 meters; bad interference; no fading.

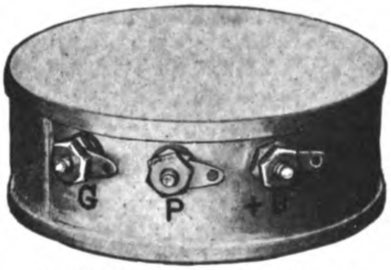
THE following stations were received and logged at the amateur station of Albert Zedelis (NU-1ALS), at 43 Banks St., Montello, Mass., using a low-loss receiver with one stage of low-frequency amplification:

EF-8ACY—March 13, 1927; signal strength R5; AC note;
EF-8TIS—March 12, 1927; signal strength R4; calling 1AL; rectified AC note;
EF-8GI—March 4, 1927; signal strength R6; rectified AC note;
EF-8PJN—March 13, 1927; signal strength R3; DC note;
EF-8DDH—March 8, 1927; signal strength R5; rectified AC note.

THE DONLE—DR4 FULL WAVE RECTIFIER TUBE— THE LATEST ADDITION TO OUR LINE OF TUBES—IS NOW AVAILABLE.

INQUIRIES CONCERNING ITS ESPECIAL DESIRABILITY FOR B ELIMINATORS, POWER PACKS, ETC., ARE INVITED.

THE DONLE-BRISTOL CORPORATION
56 CAMBRIDGE STREET
MERIDEN—CONNECTICUT—U. S. A.



Shielded Tuned Radio Transformer, No. 30

SICKLES
Diamond-Weave Coils

The new Sickles Shielded Tuned Radio Transformer prevents both outside and local interference. It is remarkably compact, sharp-tuning, sturdy.

Sickles Diamond-Weave Coils have established an enviable reputation for low distributed capacity, low dielectric losses, and large range of frequency with small variable capacity.

The ideal coil for the Na-Ald Localized Control Tuning Unit and the Na-Ald Truphonic Assembly.

There are Sickles Diamond-Weave Coils for all leading circuits.

THE F. W. SICKLES CO.
134 UNION STREET
SPRINGFIELD :: MASS.

No.	**Coil Prices**	
30	Shielded Transformer	$2.00 each
24	Browning-Drake	7.50 set
18A	Roberts Circuit	8.00 set
25	Aristocrat Circuit	8.00 set

Best by YOUR test—a confident challenge!
For All Power Work
Pat. Pend.

12 Watts
These units do not deteriorate or change in resistance value.

EL MENCO
HY-WATT
TRADE MARK
HEAVY DUTY RESISTORS

For best results with Raytheon and other power circuits you must have permanently accurate resistors capable of carrying heavy loads without change or deterioration. "HY-WATT" Heavy Duty Resistors dissipate up to 12 watts.

100—500—1000—2000—5000 ohms **$1.25**
10,000—25,000—50,000 ohms **$1.50**
100,000 ohms **$2.00**

Write for full details and literature on El Menco Gridleaks and Resistors

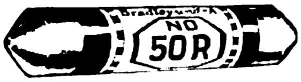
Electro-Motive Engineering Corp.
127 West 17th St. New York, N.Y.

NO 500R
Bradleyunit
PERFECT FIXED RESISTOR
This package contains
5 Bradleyunits
No. 500 R
500,000 Ohms or .5 Megohms
Bradleyunits are superior to other types of resistors because they do not vary in resistance with age, and they are not affected by atmospheric changes or moisture.
Bradleyunit Molded Resistors

Bradleyunit-A
PERFECT FIXED RESISTOR

CIRCUITS for B-eliminators, radio receivers, and other radio units usually require the use of one or more reliable fixed resistance units. In fact, fixed resistors are being used more extensively than ever, and the demand for high-grade units is growing, daily.

Bradleyunit-A is a solid molded fixed resistor, calibrated with great accuracy and fitted with silver-plated terminal caps which can be soldered without affecting the calibration of the unit. Bradleyunits are made in 20 different ratings for every purpose.



Ask your dealer for Bradleyunits, not "resistance units." They are sold in the distinctive Allen-Bradley checkered carton.

Mail this coupon to

ALLEN-BRADLEY CO.
276 Greenfield Ave., Milwaukee, Wis.

Please send me data on Bradleyunits and your folder on B-eliminator hook-ups.

Name..

Address.......................................

The BEGINNER IN RADIO

CONDUCTED BY ARMSTRONG PERRY

Aerials for Uncrowded Locations

MILLIONS of radio fans live in villages or in open country where there is no need to limit themselves to the single-wire antenna, running from the garage to the house or from pole to pole on the roof. This is a type of antenna that is typical of more thickly populated places.

The amount of energy picked up by an antenna depends partly on the amount of surface exposed to the radio waves and partly on the height of the wire above the ground. It is possible to use too much wire, but it can hardly be placed too high under ordinary conditions. There is nothing to be gained by using so much wire that the fundamental wavelength or frequency of the antenna is greater than that of the stations to be received, but distance and volume can be gained by using as large and as long an antenna as can be used without overbalancing the receiver. If the big antenna brings in too much interference, it can be cut down until some of the stations are shut out.

The illustrations show some successful antennas used in localities where there is plenty of room.

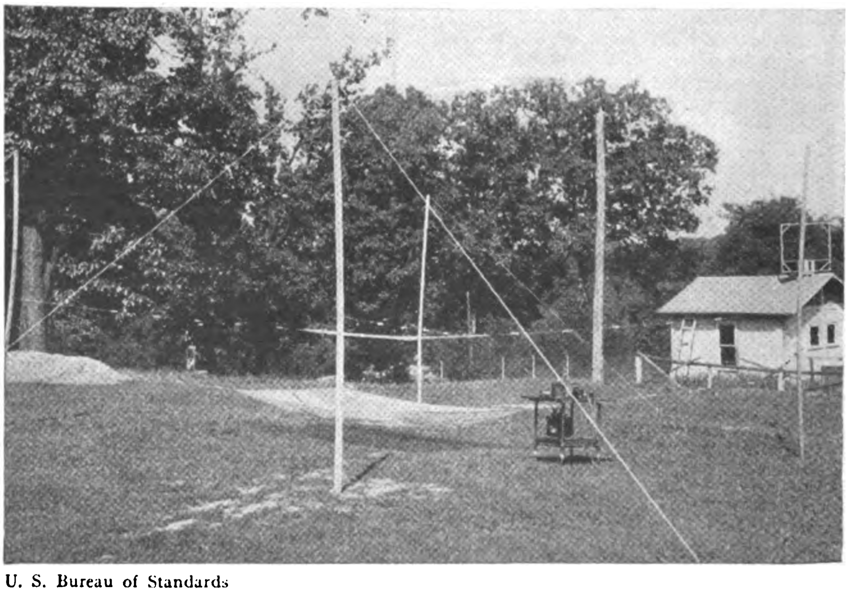
Automatic Filament Control

HAVE you ever wished that you could eliminate one more knob? You can by using an automatic filament control. It may make the vacuum valve last longer, too.

The filament of a vacuum valve is made of tungsten, about one-thousandth of an inch in diameter—almost as thin as the butter on a lunch-counter sandwich.

Tungsten in some forms is as brittle as the egg-shell found in the soft-boiled. This filament, even though made by a process that renders the metal ductile and surprisingly strong for its size, is injured easily.

Trying to make the filament blaze



U. S. Bureau of Standards

AN ANTENNA MADE FROM A WIRE FENCE

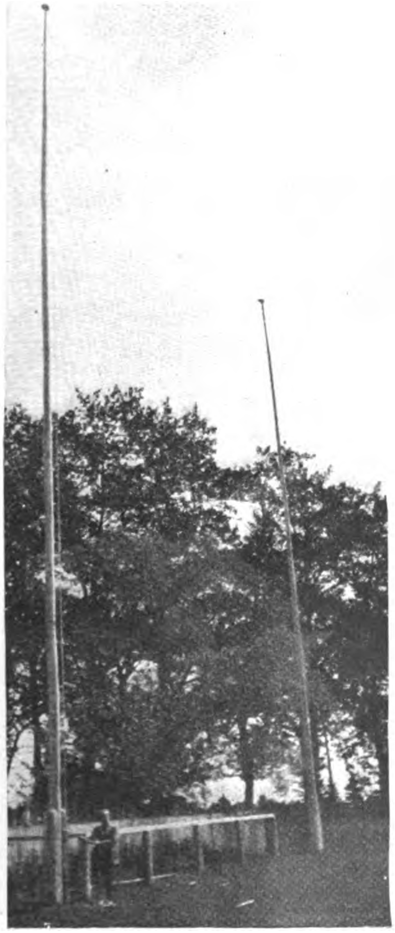
The condenser antenna in the foreground consists of two horizontal sections of wire fencing, stretched parallel to each other about a yard apart. A large outdoor loop antenna may be seen on the house in the background.

like the Gay White Way tends to vaporize the metal, because of the heat. Operating it on too low a temperature may injure it also, by increasing its brittleness. There is a temperature that is exactly correct, but even an expert finds it difficult, if not impossible, to adjust the current accurately without the help of sensitive meters that no beginner is likely to own.

There are automatic filament controls which, it is claimed, will adjust and maintain the current at exactly the correct value. There is a control for each type of valve. The device consists of a filament of metallic alloy sealed in a glass bulb filled with inert gas.

The resistance that this filament offers to a current of electricity is comparatively small when it is cold, but it increases rapidly as the metal is heated. A given length of filament of a given diameter will pass a certain amount of current, no more and no less.

For example, the control designed for the UX-201-a type valve will pass ¼ ampere when connected to a 6-volt battery. If the voltage is increased slightly, the filament of the control instantly becomes hotter and the resistance increases, so that no more cur-

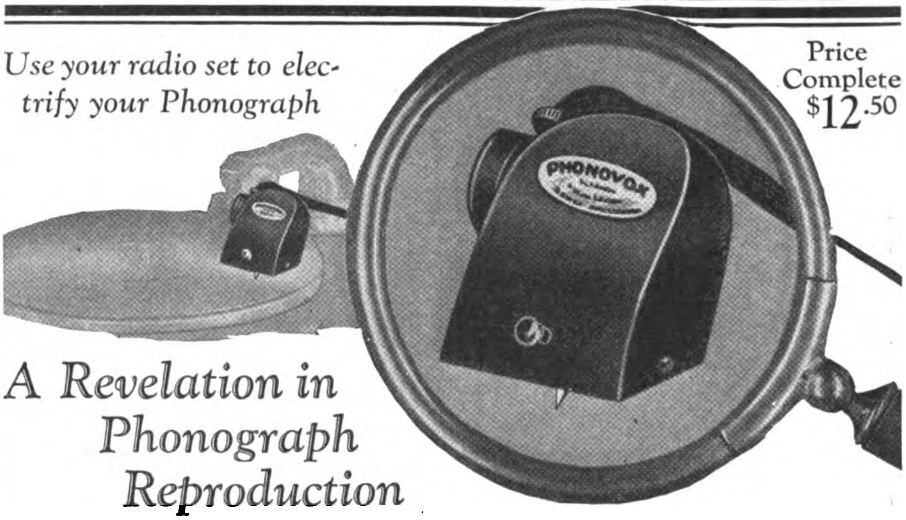


HIGH ANTENNAS MAKE FOR DISTANCE RECEPTION

These tall antenna masts are pivoted at their bases between heavy posts, so that they may be lowered easily for repairs.

Use your radio set to electrify your Phonograph

Price Complete $12.50



A Revelation in Phonograph Reproduction

THE PACENT PHONOVOX, connected to your radio set and phonograph, represents the highest attainment yet reached in magnetic phonograph pick-up devices, at a cost of less than half that of other similar devices.

The fidelity of its reproduction, the full rounded tones and the wide range of audible frequencies covered, will prove a revelation—even to the musical critic. There is no loss or fading out of the high violin and piccolo notes, so noticable with ordinary phonograph reproduction. And the zooming of the bass viols are sharp, clear, distinct—the acid test of reproduction.

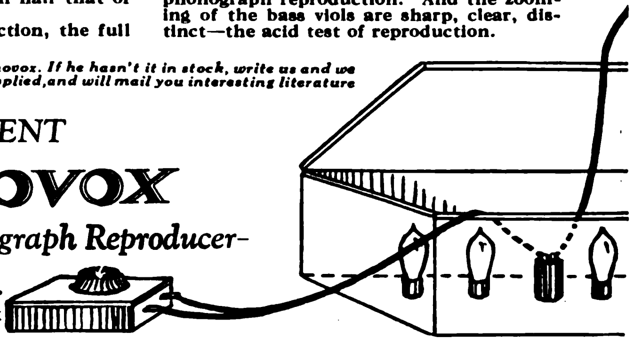
Your local dealer carries the Phonovox. If he hasn't it in stock, write us and we willsee that you are promptly supplied, and will mail you interesting literature

PACENT

PHONOVOX

—the Electric Phonograph Reproducer—

PACENT RADIO CORP.
156 West 16th St., New York



"8 hour" SERVICE on any Kit or Parts

The most complete stock of QUALITY KITS and PARTS in the CENTRAL WEST enables us to offer this unheard of service. Only GENUINE parts specified by designers are used—NO SUBSTITUTIONS—All quality Parts and Kits are stocked—even those not listed below. Any item advertised in this issue obtainable here at quoted prices. WESTERN READERS are now assured of quicker service. Send your orders for quality merchandise and pleasing, rapid service.

Bruno Unitune Receiver	$54.51
Silver-Marshall Unipac	62.00
R. G. S. Receiver	69.70
Low Frequency Amplifier	31.65
Browning-Drake Power Pack	100.15
New Browning Drake	85.45
Pre-Selector Kit	33.20
Hammarlund-Roberts Hi-Q	63.05
Varion Power Pack	55.69
Silver Shielded Six	95.00
S-C II Receiver	80.35
L-C 27 Receiver	95.20
L-C 27 Senior Power Pack	65.00
L-C 27 Intermediate Power Pack	47.50
B-T Power Six	78.13
New Remler Infradyne	112.35
Karas Equamatic	89.24
New Samson (Cotton) Super	135.69
Clough Super	80.85
Chicago Daily News Receiver	46.30
Centralab Tone Amplifier	16.00
CeCo Tubes (as advertised)	1.75 up
S-M 652 Reservoir "B" (Less Tubes)	34.50

Send only $5.00 with your order and we will ship within 8 hours any kit or part on the market—you pay balance upon delivery, plus small mailing charges. All Delivery Charges PREPAID on any kit, anywhere in the U. S., IF certified check or money order for full amount accompanies order. Prices on complete wiring of kits gladly given. SEND IN YOUR ORDER—we Guarantee real service and merchandise.

Austin-White RADIO
125-7 So. Market St., Chicago, Ill.

PILOT
ELECTRIC MFG. CO., INC.
323 BERRY ST BROOKLYN, N.Y.

World's Largest Radio Parts Producer Makes a Part for Every Radio Purpose

Complete manufacture in our own plant eliminates "outside" profits and creates world's greatest radio values.

LATEST PILOT PARTS

Shock Proof Socket
Illuminated Pilot-lite Dial
Pilot Art Dial
Centraline Condenser
Resistograd
(*For B Eliminators, Etc.*)
Pilotran Audio Transformer

PILOT PARTS ON SALE AT LEADING RADIO DEALERS, KRESGE & KRESS STORES

XL Products
Model "N" Vario-denser
Pep up Your Set!

Easier tuning—correct tube oscillation—more volume and clearness with an X-L VARIO DENSER in your circuit.

Specified and endorsed by foremost radio authorities in all leading circuits.

MODEL "N"—Capacity range 1.8 to 20 micro-micro farads. Micrometer adjustment assures correct oscillation control in all tuned radio frequency circuits, Neutrodyne, Roberts 2-tube, Browning-Drake, Silver's Knockout, Interflex circuit, Quadraformer, World's Record Super-9, B. T. Power-6, R. B. Lab. Circuit, etc. Price, **$1.00.**

MODEL "G"—For Cockaday, Oliver Lodge N, Loftin-White, Nankin Ultra-5 circuits, filter and intermediate frequency tuning in super-heterodyne and positive grid bias in all sets. Capacity range, Model G-1 .00002 to .0001 Mfd. Model G-5 .0001 to .0005 Mfd. Model G-10 .0003 to .001 Mfd. Price each with grid leak clips **$1.50.**

X-L Push Post Panel

X-L PUSH POST—Push it down with your thumb, insert wire, remove pressure, wire is firmly held. Vibrations will not loosen, releases instantly. A push post that excels in appearance, action, service and convenience. Price **15c.**

PUSH POST PANEL—7 push posts mounted on black insulating panel with permanent white markings. Soldering lugs, raising bushings, screws for mounting, etc. in box complete. Price **$1.50.**

X-L Push Post

FREE wiring diagrams showing use of X-L units in the new LOFTIN-WHITE constant coupled radio frequency circuit, and in other popular hook-ups. Send for yours today.

X-L Radio Laboratories
2422 Lincoln Ave., Chicago, Ill.

YOU
MAY NOW
HAVE THE
REALISM OF
RADIO FROM
YOUR OLD
PHONOGRAPH
BY USING THE
NEW RECORDS
AND STANDARD
RADIO AMPLIFYING
EQUIPMENT

SEE THIS AND
FORTHCOMING ISSUES OF
POPULAR RADIO

rent can pass than before. If the voltage is decreased, the temperature of the metal falls, the resistance is decreased and more current is allowed to pass.

The use of these automatic filament controls eliminates hand-operated rheostats and reduces the number of knobs on the receiver. It gives the operator one less thing to think about.

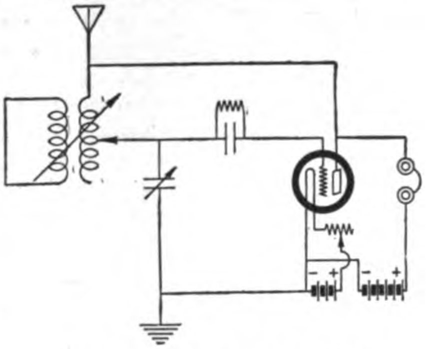
A portable set may be made smaller, lighter and easier to operate if these little automatic controls, about the size of grid-leaks, are substituted for rheostats. The beginner who likes to fiddle with a rheostat knob, however, may feel quite sure at times that if he could turn on a little more or a little less juice he could get that station whose call letters are coming in just too faintly to be understood.

A Beginner's Odd Experience

ALEXANDER MACKECHNIE, of Calvin, North Dakota, was experimenting with his one-valve receiver. It had a variocoupler, but one of his hook-ups employed the primary coil only; after trying it with fair results, he joined the leads from the two ends of the secondary coil. The hook-up is shown in the diagram on this page.

Immediately the stations began to come in louder.

It is difficult to explain why the joining of the two ends of the secondary coil should improve reception so much as he says it did. Leaving the secondary coil out of the consideration, his circuit resembles the single-circuit De



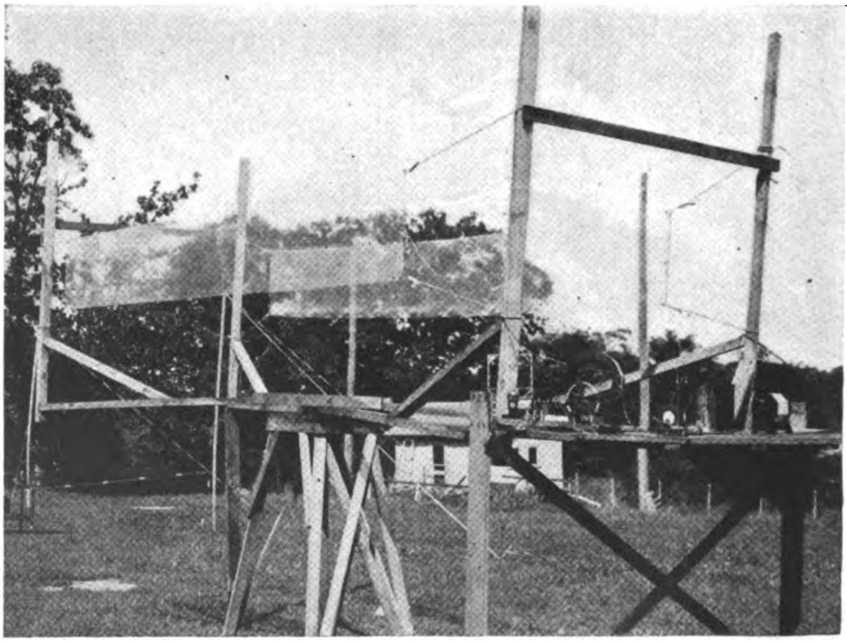
A BEGINNER'S HOOK-UP

At the left is shown the variocoupler with the secondary winding shorted. The closed secondary circuit probably acts as an absorption circuit.

Forest ultra-audion hook-up, except that the grid is connected to the end of the coil farthest from the antenna and the plate to the end nearest the antenna. These two connections are reversed in the usual ultra-audion diagram.

The secondary coil, with the ends joined, can absorb some energy from the primary coil, and the amount can be varied by turning the rotor and thus varying the coupling. It is unlike the wavetrap, or interference eliminator, because there is no condenser in its circuit and it is not conductively connected to the antenna.

It would seem that its effect on reception must be similar to that of **"body capacity," which often is noticeable, especially in unshielded sets, when the hand is placed on a tuning knob. Sometimes a hand placed near a certain spot on a receiving set will more than double the volume of a signal that is being received.**



U. S. Bureau of Standards

ANOTHER TYPE OF FENCE-WIRE ANTENNA

Here is another condenser antenna made out of fencing wire; it was used in experimental work by the United States Bureau of Standards. It was found to be more efficient than the one shown on page 78.

Universal
CLAROSTAT
Universal range
Carrying capacity
20 watts.
List $2.25

CLAROSTAT

To an even greater extent than in past seasons, CLAROSTAT, the greatest variable resistor, will be identified with the leaders—in receivers, in B eliminators, in power amplifiers and in A, B, C units.

POWER
CLAROSTAT
Universal
range
Carrying
capacity
40 watts.
List $3.50

Write for complete information
American Mechanical Labs., Inc.
285 N. 6th Street Brooklyn, N. Y.

Astounding!

"The only word that describes the reproduction of the 'ENSCO' 3 foot Cone or Roll type Speaker." The statement of one of the foremost Acoustic Engineers.

KIT GENUINE KIT
$10 "ENSCO" $10

Why has "ENSCO" been endorsed by all leading magazines and the foremost newspapers? Because—it is the most highly developed big cone assembly now offered to the public; it reproduces all frequencies and greatly reduces static. The "ENSCO" unit is the only direct-drive unit for large cone speakers.

Manufactured under U. S. Patent No. 1630119; "ENSCO" Cushion Drive Patent No. 1163854; Cone Diaphram Patent No. 1003655 and other patents pending.

Assemble the "ENSCO" speaker in less than an hour. It works on any set with any power. No filters or chokes necessary, 90 to 250 volts without protection or 500 volts with transformer.

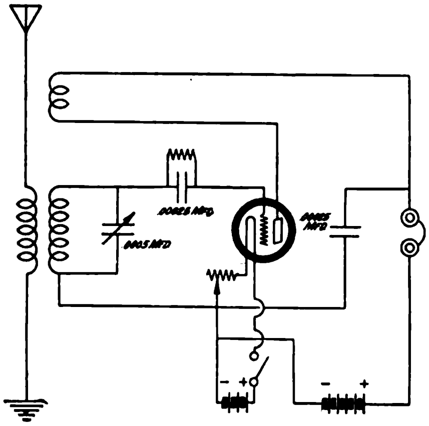
Six different types to choose from. Cones beautifully decorated and marked for assembly: Wall, pedestal or console; all fully described in illustrated instruction book.

Sold under absolute (money back) guarantee.

Engineers Service Co.

25 Church St. - - - - - New York City
73 Cornhill - - - - - - - - - - Boston
28 E. Jackson Blvd. - - - - - - Chicago

Ask your dealer or mail order to nearest office. Send money order, check or cash, or we will ship C. O. D. We pay shipping charges.



A CIRCUIT THAT GOT CUBA

Here is a simple one-tube, three-circuit tuned set that is capable of receiving at great distances.

A One-Tube Distance Getter

OSCAR BIRDSALL, who lives in Michigan, sends us the above hook-up which he has used with good success.

With this regenerative receiver and one stage of audio-frequency amplification, Oscar says he brought in Cuban and Mexican stations during the international tests.

A good three-circuit tuner, a variable condenser of .0005 mfd. capacity, and a 20-ohm rheostat are needed, he says, together with the other pieces of apparatus shown on the diagram.

What hook-ups get the longest distances for you? Write to us about them.

Fleet Photo Service

A TALL-TIMBER ANTENNA

In the summer camp, where there are plenty of tall trees and no neighbors to object, the antenna should be made high and long; this will enable you to tune in the distant city broadcasting.

YAXLEY
APPROVED RADIO PRODUCTS

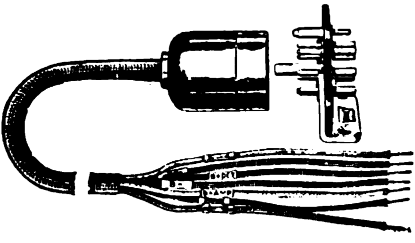
Automatic Power Control

When you turn the switch on your set, the Automatic Power Control switches on the B eliminator and cuts out the trickle charger; and the reverse takes place when you turn off the set. Easily attached—perfectly reliable.

No. 444 — Series Type Automatic Power Control — Now furnished in the new construction, exclusively Yaxley, to take care of sets having a current draw from four 199 type of tubes up to eleven 201 type of tubes, keeping the voltage drop below 2/10 volts....$5.00

No. 445—Multiple Type Automatic Power Control—for all tube sets $6.00

Cable Connector Plug



Simplifies battery wiring, eliminates old-fashioned unsightly mass of wires, and is a positive guarantee of an instant and correct battery connection. Bakelite construction, neat and handsome in appearance. Metal cable markers and colored chart (RMA standard color code) on the connector plate simplifies installation on any set. Phosphor bronze double contact springs are mounted in Bakelite and cannot work loose. Connector plate has brass contact pins, tinned for soldering, mounts on reversible bracket adaptable for sub-panel mounting. Extra fine quality, seven-strand (RMA standard colors) five foot cable. Six extra markers packed with each plug.

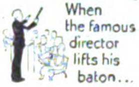
No. 660—Cable Connector Plug, complete $3.50

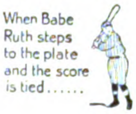
At your dealer's. If he cannot supply you, send his name with your order to

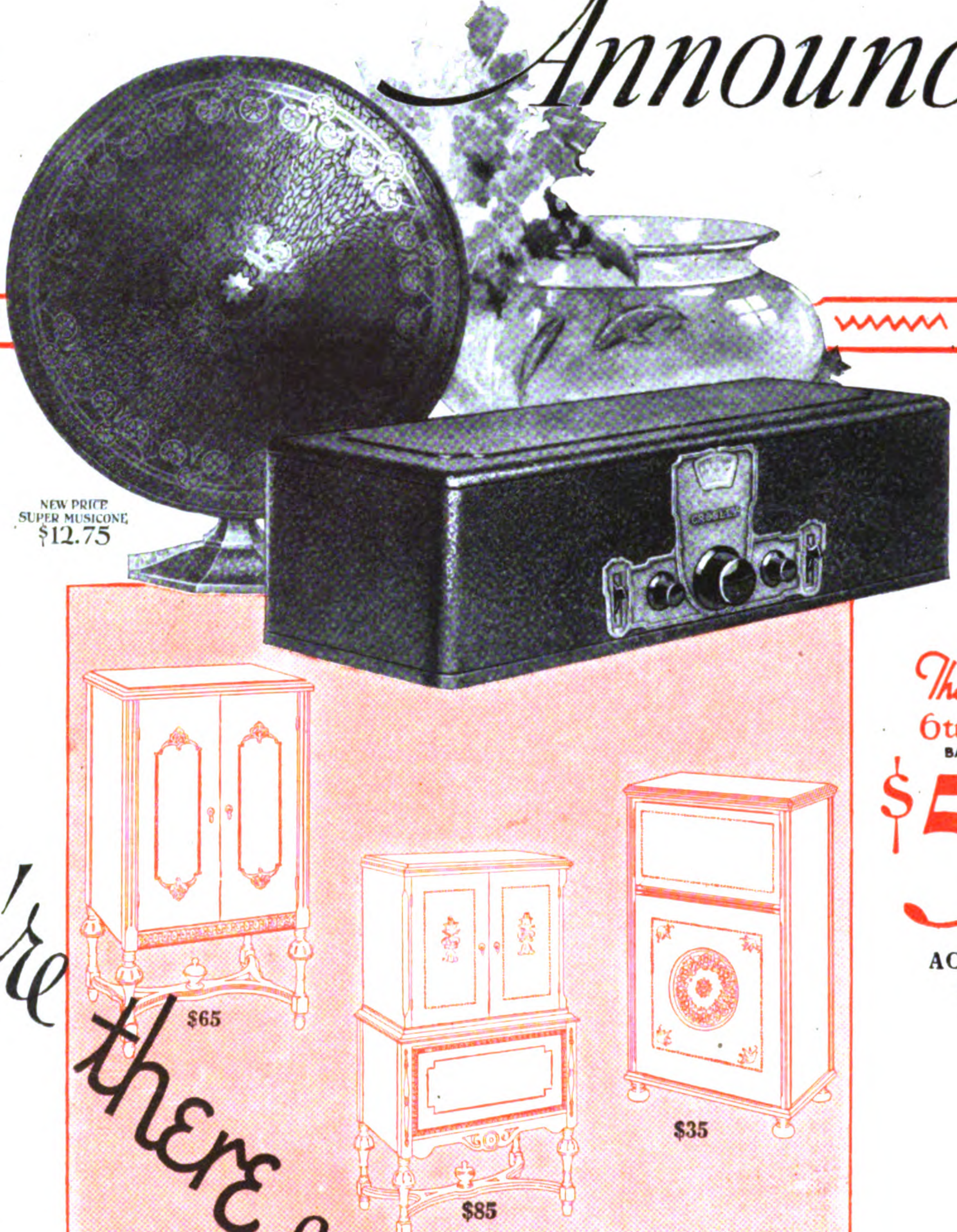
YAXLEY MFG. CO.
Dept. P 9 So. Clinton St.
CHICAGO

Announcing

—When the gong rings for the big fight.....


When the famous director lifts his baton...


When Babe Ruth steps to the plate and the score is tied......



The "BANDBOX"
6 tube receiver
BATTERY TYPE
$55.

AC TYPE
$65

"You're there with a Crosley"

Approved Crosley Consoles

These three handsome cabinets, especially designed to receive the shielded chassis of the "Bandbox" and other Crosley receivers, have been approved by Powel Crosley, Jr., as mechanically and acoustically ideal for the installation of Crosley Radios.

H. T. ROBERTS CO.
914 S. Michigan Ave., Chicago, Ill.
Sales Agent for Approved Console Factories
SHOWERS BROTHERS COMPANY
The Wolf Manufacturing Industries

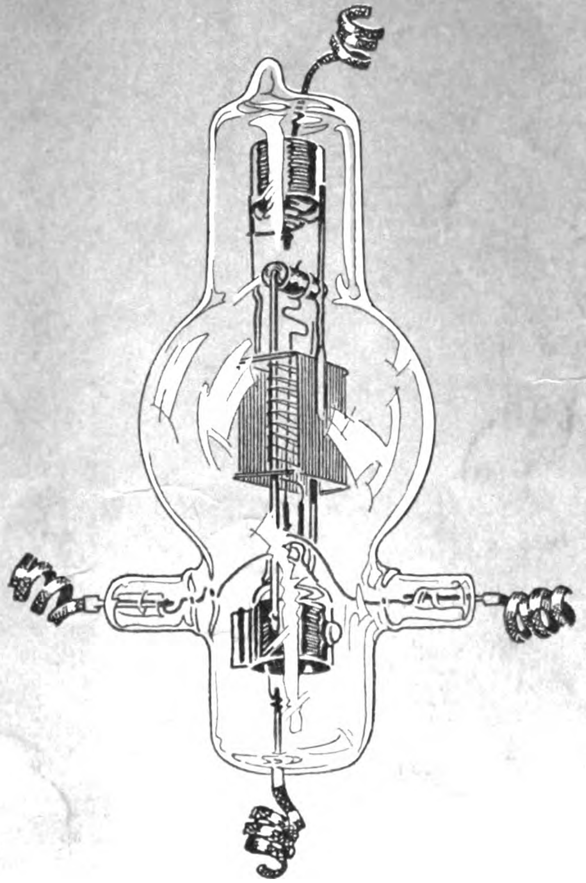
SEP 23 1927

Engineering
Library

Popular Radio

SEPTEMBER · 1927

25¢



—For the Experimenter—

How to Utilize the New AC Valves

—Page 144

A World's Record!

Tokyo, *Japan* to Hoboken, N. J. with ZETKA *Clear-Glass* Tubes

East meets West in 7270 mile radio hop

ON April 15, 1927, Arthur Wald of Hoboken, New Jersey, made a new World's Record for DX reception—7270 air miles . . . Station JOAK of Japan—the longest distance bridged in radio history, according to the New York *Evening Telegram.*

> *"I recommend the use of Zetka Tubes to any one who is deeply enough interested in radio to want the best equipment it is possible to secure.*
>
> *"Zetka Tubes have given me infinitely more power, greater distance, better tone qualities, and a complete freedom from microphonic noises, way beyond any other tubes I have ever used."*
>
> Arthur Wald

Announcement—3 Special Duty Tubes

With the cooperation of Laurence M. Cockaday, Zetka Laboratories have produced a new Radio Frequency Amplifier. The ZRF, another ¼ amp. clear-glass tube operating at 3 to 5 volts.
Price $4.50

Z 200 A has been perfected as a super-sensitive detector. Unlike the usual 200 A, the Zetka clear-glass Z 200 A is free of the objectionable noise and hiss.
Price $4.00

For Audio Amplification—ZP 201 A has been improved and made more rugged. Can also be used as detector with marked improvement over ordinary 201 A type tubes—but not quite as sensitive as Z 200 A.
Price $3.50

ZETKA
The *Clear-Glass* Tube

ZETKA LABORATORIES, INC., 73 WINTHROP ST., NEWARK, N. J.

General Electric Battery Chargers

$10

$14

$24

New Prices
(East of the Rockies)

2 ampere Tungar . now $14
5 ampere Tungar . now $24
G-E Trickle Charger now $10

Tungar causes no radio interference. It cannot blow out tubes.

An overnight charge costs a dime.

It is a G-E product developed in the Research Laboratories of General Electric.

The 2 or 5 ampere Tungars charge 2, 4, and 6 volt "A" batteries, 24 to 96 volt "B" batteries in series; and auto batteries, too. No extra attachments needed.

KEEP your radio set ready—at all times—for all the good things that come over.

Just clip a Tungar [the name of the General Electric battery charger] to your batteries at night, leave it as you would the light in the hall ..... in the morning the batteries are pepped up and ready for active duty.

Your dealer can help you. Ask him to show you the popular 2 ampere Tungar that charges both "A" and "B" radio batteries. *It has a binding post for a trickle charge.* Charges auto batteries, too.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

GE Tungar
REG. U.S. PAT. OFF.
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

GENERAL ELECTRIC

Popular Radio

FOUNDED 1911

VOLUME XII September, 1927 NUMBER 3

CONTENTS

(*Cover design by Frank B. Masters*)

Just Before He Broke the World's Altitude Record for Radio Broadcast Reception

FRONTISPIECE..........PAGE 110

A Broadcast Experiment in Sending Thought-waves *via* Ether

Does the brain create ether vibrations that may be received without the mediation of the senses? Here is an answer by a man noted both as a radio experimenter and a student of psychic phenomena—

Sir Oliver Lodge, F.R.S., D.Sc., LL.D..... PAGE 111

How to Make the Exponential Horn

Constructional details for building a horn that embodies the latest findings in acoustical science

By W. F. Sutherland......PAGE 114

Adventures in the Air.............PAGE 118

How to Add to Your Old Phonograph a New Amplification Unit

The second of a series of articles on how to broaden the range of the radio receiver by making it able to reproduce phonograph programs

By Raymond Francis Yates....PAGE 120

The New "Multiplex Valves"

A new development in valve construction whereby a single valve serves as an entire amplifier, as told by one of the developers of the device—

Manfred von Ardenne......PAGE 124

A New Form of Radio Waves That Kill

By W. Gordon Swan......PAGE 127

Advance Information on the Magnaformer 9-8 Receiver

Preliminary data on a superheterodyne that is easy to construct and that gives excellent results on either nine or eight valves

By Laurence M. Cockaday....PAGE 128

"Embalming" Radio Programs in Wax

By S. T. Williams.......PAGE 131

What's New in Radio

By the Technical Staff......PAGE 132

How to Build the Aero 7 Receiver

Constructional details for building a receiver that employs high-mu amplification throughout

By Zeh Bouck.........PAGE 140

Practical Hints for Operating the New AC Valves

Experimenter and fan alike should find interest in this article, which tells how to make the best use of the recently developed AC valves

By Albert G. Craig.......PAGE 144

Advance Information on the LC-28 Receiver

The new theory of high-frequency amplification and its application to radio reception, as embodied in the new LC-28 receiver

By Laurence M. Cockaday....PAGE 148

"Can I Learn Radio by Mail?"

By Armstrong Perry.......PAGE 151

DEPARTMENTS

Star Program Features of the Month......................152
With the Experimenters........*S. Gordon Taylor*..........162
In the World's Laboratories....*E. E. Free*................168
Listening In..................*David Lay*................182
Broadcasts 190

VOLUME XII September, 1927 NUMBER 3

Published monthly by Popular Radio, Inc., 627 West 43rd St., New York, N. Y.; telephone number, Chickering 1906; Douglas H. Cooke, President and Treasurer; Kendall Banning, Vice-President; Laurence M. Cockaday, Secretary; Emma A. Harm, Asst. Treasurer. Price, 25 cents a copy; subscription, $3.00 a year in the U. S., Canada and all countries within the domestic postal zone; elsewhere, $3.50 a year, payable in advance. The International News Company, Ltd., No. 5 Bream's Bldg., London, E. C. 4, sole distributors in England. Entered as second-class matter April 7, 1922, at the Post Office at New York, N. Y., under the act of March 3, 1879. Additional entry at Jamaica, L. I., N. Y. Copyright 1927, and title registered as a trade-mark by Popular Radio, Inc. Copyright in Great Britain by Popular Radio, Inc., 6 Henrietta St., Covent Garden, W. C., London, England. *For advertising rates, address* Popular Radio, Inc., 627 West 43rd St., New York; or 225 North Michigan Ave., Chicago.
Printed in U. S. A.

KENDALL BANNING, *Editor*

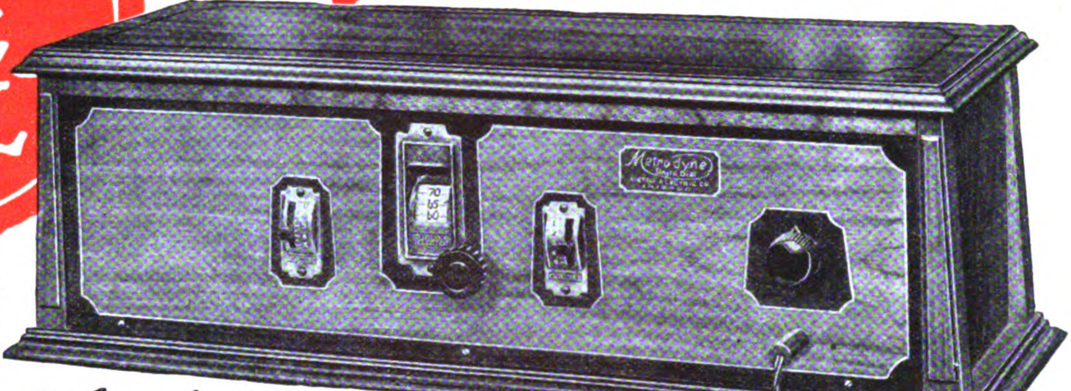
LAURENCE M. COCKADAY, *Technical Editor*

E. E. FREE, Ph.D., *Contributing Editor*

30 DAYS FREE TRIAL

7 Tube Set

Single Dial Radio



Metrodyne Radio Sets
Are Equipped For
BATTERY or ELECTRIC operation

The Metrodyne

ONLY ONE DIAL TO TUNE

RETAIL PRICE
$75.00
Completely Assembled
Big Discounts to Agents and Dealers

Wonderful offer direct from the factory! The world's greatest radio! A perfect working, single dial control, 7 tube receiver! And just to prove our claims, we will ship it to your home for 30 days' free trial. Test it under all conditions. Test it for distance, volume and tonal quality—and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

Three Year Guarantee

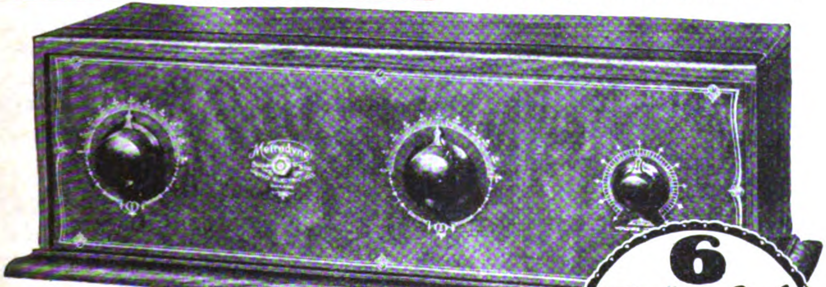
BIG PROFITS TO AGENTS AND DEALERS

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon, a letter or a postal for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. **Tested and approved by Popular Science Institute of Standards, Popular Radio Laboratory, Radio News Laboratory** and by **America's leading Radio Engineers.** Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet with beautiful, gilt metal trimmings. Very newest 1928 model, embodying all the latest refinements.

Easiest set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, **1,000 to 3,000 miles on loud speaker!** The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.



6 Tube Set
$48.50
RETAIL PRICE
Completely Assembled

30 Days' Free Trial—3 Year Guarantee

Metrodyne Super-Six

Another triumph in radio. Here's the new 1928 model Metrodyne 6 tube, two dial, long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. Highest grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station on same dial readings every time — no guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal 30 days' free trial offer, which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis.

MAIL COUPON BELOW

Let us send you proof of Metrodyne quality—our 30 days' free trial offer and 3 year guarantee

Mrs. Wm. Leffingwell, Westfield, N. J., writes: "The Metrodyne Radio I bought of you is a wow! This is as good as any $225 machine I have ever seen."

N. M. Greene, Maywood, Ill., writes: "My time is up and the Metrodyne works fine. I got Havana, Cuba, Oakland, Calif., Denver, Colo., Toronto, Canada, all on the loud speaker."

J. W. Woods, Leadville, Colo., writes: "Received the 7-tube Metrodyne in fine condition. Had it up and working same day received. Was soon listening to Los Angeles, San Diego, Oakland and other California points; also St. Louis, Kansas City and other east and south stations—all coming in fine. Am more than pleased. Sure enjoying it."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer.**

MAIL THIS COUPON
or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer—SAVE MONEY—WRITE NOW!

METRO ELECTRIC COMPANY
2161-71 N. California Ave., Dept. 6
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer.**

*Name*______________________________

*Address*____________________________

If you are interested in AGENT'S proposition, place an "X" in the square ➔ ☐

METRO ELECTRIC COMPANY

2161-71 N. California Ave. • *Dept.* 6 • Chicago, Illinois

A PAGE WITH THE EDITORS

By the time this September issue of POPULAR RADIO reaches its readers, the quiescent summer season of radio will be over and the fall season will be looming with greater promise—and with more and better cause for promise—than any season in the history of the radio art.

* *

POPULAR RADIO believes that the coming radio year (which begins with the first cool days of September), will be the best year that radio has ever known. The reasons for this belief may be summarized thus:

* *

First.—Because the Federal Radio Commission, with commendable efficiency and dispatch, has been clearing up the broadcasting situation and has already brought order out of the ethereal chaos:

* *

Second.—Because recent important legal decisions have made material headway in clearing up the complicated patent situation—which has, in turn, helped to stabilize the radio industry, to the benefit and protection of the industry and of the broadcast listener alike:

* *

Third.—Because during the past few months new and greatly improved low-frequency apparatus has been developed and placed at the disposal of the radio public. (See the series of articles on this important subject now appearing in POPULAR RADIO.)

* *

Fourth.—Because the current summer has at last seen the successful development of the electrical pick-up units that make possible extraordinary reproduction and amplification of phonograph records, by the use of radio apparatus—a development that is opening up new possibilities of entertainment to both the radio and the phonograph fan as well as to the radio and phonograph industries. (See the series of articles on this new subject now appearing in POPULAR RADIO.)

* *

Fifth.—Because the past few months have witnessed by far the greatest and most significant development of special duty and AC vacuum valves that the industry has ever known—thereby opening up not only a limitless field of experimentation to the radio amateur, but greatly increasing the quality of reception for the broadcast listener. (See the July-August issue of POPULAR RADIO, which was devoted largely to these new inventions.)

* *

Sixth.—Because of the advances made in the development of loud-speaker in general and of the new "exponential horn" in particular. (See pages 22-24 of the July-August issue of POPULAR RADIO, as well as the constructional article in this issue.)

* *

Seventh.—Because of the progress that is being made in the development of radio circuits, made possible by the introduction of new inventions and apparatus—that places at the disposal of the broadcast listener better reception at less expense than ever before.

* *

THAT the staff of POPULAR RADIO has been in intimate touch with all of this progress (indeed, that it has been responsible for a considerable part of it, through the activities of the POPULAR RADIO Laboratory), has been demonstrated in the magazine itself.

* *

AND that POPULAR RADIO is destined to render an important service to the radio fan as well as to the radio industry, during the coming season, will be convincingly demonstrated with the introduction of the latest and best contribution that POPULAR RADIO has yet made to the radio art in the remarkable new LC-28 Receiver—which is announced in this number (see page 148), to be followed up by the complete constructional details in the October number.

* *

FOLLOWING these important contributions, POPULAR RADIO will bring out a series of new features that will be of widespread interest and significance—features that serve as the practical expression of the optimism with which POPULAR RADIO surveys the season that unofficially opens on Labor Day.

* *

THE world-wide interest in the experiments recently made in England in "broadcasting telepathy," or mind reading, is due not only to the general belief that science has much to learn in this field, but also to the fact that these particular experiments were carried out on a large scale and under distinguished scientific supervision.

* *

FOR many weeks the results of these experiments were carefully studied and tabulated; they are finally summarized in the article by Sir Oliver Lodge, beginning on page 111 of this issue of POPULAR RADIO.

* *

WHILE the results of these particular experiments are termed "negative," other similar experiments have furnished more encouragement—according to the incomplete reports of those who conducted them.

* *

IN 1923 what are claimed to be the first tests in the broadcasting of telepathic impulses were conducted by E. F. McDonald, Jr., from station WJAZ in Chicago.

* *

AND during April, 1927, Pierson W. Banning, of Los Angeles, conducted like experiments from station KFXB at Bell, California.

* *

"ASTONISHING results were received from a distance of nearly 140 miles." reports Mr. Banning. "While further evidence from various distances will help build up a really remarkable report when released."

* *

W. FRANK SUTHERLAND, who wrote the article on pages 114-117 of this issue, "How to Make the Exponential Horn," is by profession an electrical engineer. His interest in music has drawn him into the problems of radio reception—particularly into the problems of quality reproduction. His exponential horn is a real contribution to the radio art.

* *

IN POPULAR RADIO for this month will appear the first and only authorized description of POPULAR RADIO'S latest and best contribution to the radio art—the new LC-28 Receiver.

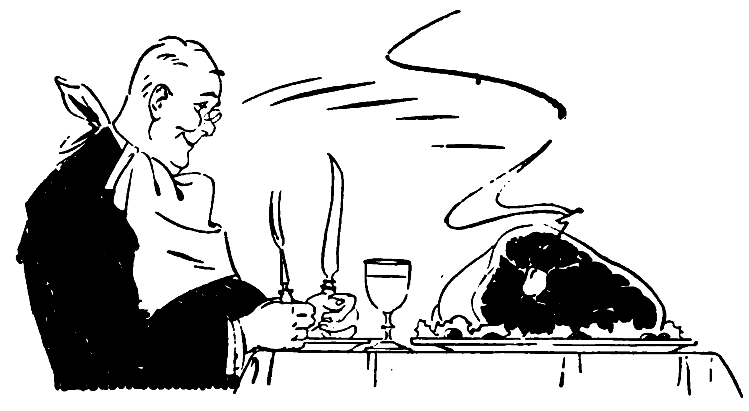
* *

AND in the October number will be published the complete constructional details.

* *

IN its principles of operation, in its simplicity of design and construction, in its moderate cost, and above all, in the extraordinary quality of its reception, the LC-28 receiver represents a highly important contribution to the radio art—more important than the famous Four-Circuit Tuner, the remarkable LC-27, or the various other receivers that have been developed in the POPULAR RADIO Laboratory.

—THE EDITORS



You wouldn't stuff yourself tonight —then go hungry all next week!

DON'T expect your radio storage battery to bring in programs loud and clear when you work it day after day without replenishing the power. Keep the battery strong and active by feeding it regularly — with a Rectigon Home Charger.

Charge at trickle or high rate — Rectigon does both.

With the Rectigon you can get a steady "trickle" to replace "A" power as you use it. In case of heavy drains due to prolonged use of the set, by a mere rearrangement of the leads you charge "A" or "B" batteries quickly, at a heavy rate. Either way, when you turn on your radio, you have power to spare. There are no acids or chemicals with Rectigon — no moving parts. You just attach the leads and plug into the light socket. It will charge your automobile battery the same quiet, "no trouble" way.

At your radio store, Rectigon, the many purpose charger. Look for the name on the plate.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PENNSYLVANIA
OFFICES IN ALL PRINCIPAL CITIES ' REPRESENTATIVES EVERYWHERE ' TUNE IN WITH KDKA—KYW—WBZ

BESIDES Rectigon for better battery charging, Westinghouse also makes Micarta Panels and tubing for better insulation, and radio testing instruments for better reception.

Rectigon Home Charger
for radio and automobile storage batteries.

Westinghouse

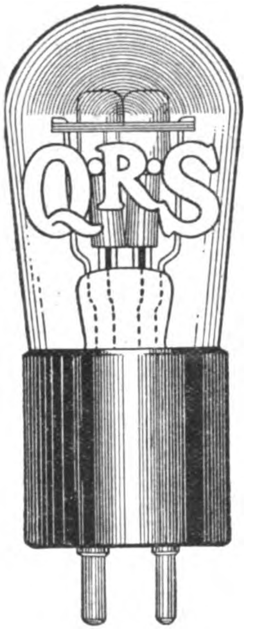
Your "B" Battery Eliminator will give you better service with

Q·R·S

(Trade Mark Registered)

Gaseous Rectifier Tubes

ARE BETTER



60 Milliamperes	-	$4.50
85 Milliamperes	-	4.50
400 Milliamperes	-	7.00

Ask for Catalog of full line of Standard Tubes.

Guaranteed

The standing of the Q·R·S Company, manufacturers of quality merchandise for over a quarter of a century, establishes your safety.

Orders placed by the leading Eliminator Manufacturers for this season's delivery, approximating Four Million Dollars' worth of Q·R·S Rectifier Tubes, establishes the approval of Radio Engineers. Ask any good dealer.

THE Q·R·S COMPANY

MUSIC

Manufacturers

Executive Offices: 306 S. Wabash Ave., Chicago

Factories: Chicago—New York—San Francisco—Toronto, Canada—Sydney, Australia—Utrecht, Holland

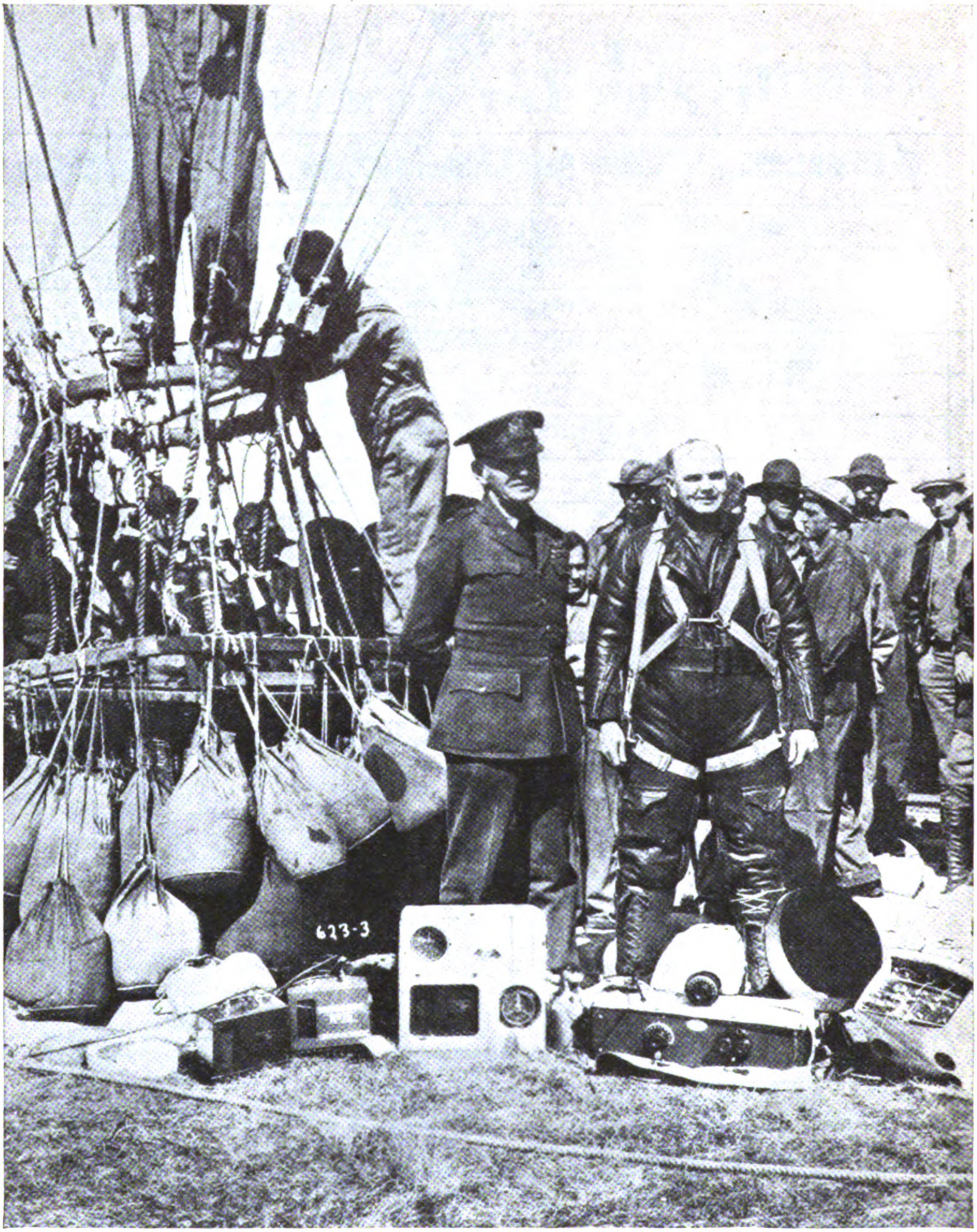
Established 1900. References—Dun, Bradstreet, or any bank anywhere

The RADIO ALMANAC

September, 1927

● **Full Moon, 4th Day 5 h. 44 m., morning, W**

D.M.	D.W.	**Notable Events and Anniversaries**
1	Th.	1896: GUGLIELMO MARCONI, a young Italian inventor, succeeded at this time in transmitting a radio message 100 yards; SIR WILLIAM PREECE referred to Marconi's device as "highly novel and very beautiful."
2	Fr.	1869: HIRAM PERCY MAXIM, scientist, inventor, founder and president of the Amateur Radio League, was born. *Good radio weather starts about now.*
3	Sa.	1921: The first licenses to broadcast in the United States were issued by the Department of Commerce. *Tune in on sporting events.*
4	S	☽ 1897: Radio receiving apparatus was set up at Bath, England, and signals were received from Salisbury, thirty-four miles away.
5	M.	1914: PRESIDENT WILSON issued Executive Order No. 2042, providing for the taking over by the U. S. Government of certain high-powered station for transatlantic communication, as a war measure.
6	Tu.	1925: During this period the radio compass (or "direction finder") came into use on over 100 United States vessels. *Warm.* ☼
7	W.	1840: JOSEPH HENRY, an American school teacher, first produced high-frequency electric oscillations and pointed out that the discharge of a condenser is oscillatory.
8	Th.	1892: SIR WILLIAM PREECE showed that in two completely isolated circuits of square form (each side 400 yards), placed one-quarter mile apart, telephonic speech was conveyed from one to the other by induction.
9	Fr.	1887: HEINRICH HERTZ made his first discoveries of the "Hertzian waves" that are now called "radio waves."
10	Sa.	1886: WILLIAM STANLEY devised his electric current transmission system. *Take the portable receiver along on that motor ride!*
11	S	○ 1838: STEINHEIL discovered the use of earth return. *Church services will be broadcast this morning.*
12	M.	1906: DR. WILLIAM G. PICKARD discovered the rectifying properties of silicon crystals. This discovery formed the basis of the widely used crystal detectors.
13	Tu.	1913: During this month the radio station at Macquerie Island was the means of keeping DR. MAUSON, the Australian explorer, in touch with the civilized world.
14	W.	1926: Of the chief broadcasting stations in the United States, 124 were owned by mercantile concerns, 94 by schools and colleges, 43 by churches, 35 by publishing houses, 30 by manufacturers, 15 by states and cities and 15 by banks.
15	Th.	1926: A new record in broadcasting was established when a hook-up of thirty-three stations broadcast the proceedings of the Radio Industries' dinner in New York; the program included a speech by Vice-President Dawes.
16	Fr.	1926: During this year the sale of radio apparatus exceeded $4,000,000—an increase of 400 percent. over the year 1921.
17	Sa.	☾ 1899: The international yacht races which took place at this date were reported by radio for the *New York Herald.* *Kinder warm.* ☼
18	S	1926: Radio amateurs played important and heroic rôles in rescuing the victims of the tornado that swept the eastern coast of Florida.
19	M.	1922: The Franklin Medal was awarded to SIR JOSEPH JOHN THOMSON, "in recognition of the immeasurable service he has rendered . . . in that domain of science especially related to a fundamental knowledge of electricity."
20	Tu.	1924: POPULAR RADIO brought out the two-tube reflex receiver, which was developed by its technical staff in the Popular Radio Laboratory. 1791: Michael Faraday was born.
21	W.	1926: DR. GEORGE WYETH, of the Vanderbilt Clinic, New York, announced that he had been able to perform successful operations in cases of cancer by means of a knife that uses a radio current.
22	Th.	1918: Radio messages transmitted from Carnarvon, Wales, were received in Sydney, Australia, 12,000 miles away—a record distance.
23	Fr.	1926: The Royal Typewriter Company paid a record price for the privilege of broadcasting the Tunney-Dempsey fight for the world's heavyweight championship in Philadelphia.
24	Sa.	1869: DR. JOHN STONE STONE, inventor of many radio appliances and winner of the Edward Longstreth Medal and of the Medal of Honor of the Institute of Radio Engineers, was born.
25	S	● 1889: DR. ELIHU THOMPSON, physicist and authority on radio phenomena introduced electric welding. *A good day to get the old receiver in working order.*
26	M.	1927: At about this time look on the news stands for the October number of POPULAR RADIO, which will contain the constructional details of the new and remarkable LC-28 radio receiver.
27	Tu.	1903: VALDEMAR POULSON, a Dane, invented the improved arc oscillation generator, using a hydrocarbon atmosphere and a magnetic field.
28	W.	1901: PROF. REGINALD A. FESSENDEN applied for a United States patent on his invention "for the wireless transmission of electromagnetic wave, relating to the transmission and reproduction of words or other audible signals."
29	Th.	1918: The installation of the radio apparatus on merchant vessels gained marked headway; at about this time over 2,500 ships of the British Merchant Marine carried radio sets.
30	Fr.	1926: The broadcasting of a warning reached a man in Birmingham, England, in time to prevent him from taking pills that contained arsenic, which had been sold to him accidentally by a local druggist.



Just Before He Broke the World's Altitude Record for Radio Broadcast Reception

What is believed to be the highest broadcast reception ever recorded was turned in recently by Capt. Hawthorne C. Gray, of the U. S. Army, in an ascent in a free balloon from Scott Field, Illinois. Up to the time that the aviator became unconscious at 31,000 feet, the receiver was working satisfactorily, "with a total lack of interference." The loop antenna made it possible for Capt. Gray to determine his bearings at all times; stations KMOX and KSD each indicated their true direction by the maximum volume obtained when the stations came in the plane of the loop. The apparatus used (as shown in the foreground of the picture above) was an Atwater Kent Model 32, a seven-tube, radio-frequency receiver with a single-dial control.

Popular Radio

VOLUME XII September, 1927 NUMBER 3

A BROADCAST EXPERIMENT IN SENDING

Thought-Waves *via* Ether

Does a thought, created by the brain, excite vibrations in the ether to which a distant brain can respond? If so, there is a close analogy between the "telepathic" process of transmitting messages and the radiophonic process. Certainly the subject is of vast interest and importance. Here is an authoritative report of the first important broadcast experiment in this field, in which 25,000 radio fans took active part, written by the eminent English physicist who officiated in it—

SIR OLIVER LODGE, F.R.S., D.Sc., LL.D.

AMONG scientific men there still persists some disbelief in the possibility of communication of mind with mind by other than the usual sense organs; but even among them there are many who believe that a telepathic faculty has been shown to exist; and, indeed, in some quarters there has been a tendency to press it unduly far, and to use it as a *vera causa* for the explanation of phenomena which may not really be thus explicable.

The object of the experiment conducted by officials of the Society for Psychical Research on February 16, 1927, at 11 P. M., with the essential assistance of the British Broadcasting Corporation, was not to prove the existence of telepathy, but to make a sort of psychological experiment as to the unknown conditions in which some kind of telepathy might possibly occur.

In my view, telepathy between relatives and between people in the same room had been fairly proven. But telepathy between unknown strangers at a distance had never been proven or even tested. It seemed desirable to utilize the facilities now afforded by twentieth century developments, and to make at any rate a preliminary test as to whether such telepathy ever really occurred, by trying whether any evidence could be obtained of the telepathic transmission of ideas from strangers about whom the receivers knew nothing, or about whom they only knew, as in the present instance, that they were in a certain place at a certain time.

The conditions of our broadcast experiment were, in fact, about as difficult as could well be imagined. Few of us had any hope of a clearly defined and positive result, still less of anything that could be called sensational. The word "expectation" is better than the word "hope" in such a case, for our only object was to ascertain the truth, whatever it might be; and without fuller knowledge than we possess we ought not to "hope" for any particular result, but simply put ourselves in a position to ascertain it.

It is very seldom that a laboratory experiment is conducted in public, except for purposes of demonstrating something already ascertained. Many experiments must fail, and these are generally either passed over in silence, or recorded in "Transactions" for the benefit of other workers.

In this case it was necessary to experiment in full view of the public, and without the kindly co-operation of the many listeners distributed all over England we could not have proceeded. To their co-operation we are indebted, and it seems only fair that they should be informed what the results were.[*]

I also think it is only right to say that an analysis of the results has been carried out by one of the members of the Society for Psychical Research, Mr. S. G. Soal, in very great detail; that not only successes have been attended to, but that the various unsuccessful guesses have also been classified, under such heads as lethal weapons, musical instruments, grotesque objects, medical suggestions, pictures of the Royal Family, Madonna, and other subjects.

The number of times each of the 52 playing cards appeared in the results has also been analyzed. Thus a good deal

---

[*] A more elaborate and detailed statement will in due time be published in the "Proceedings" of the S. P. R. by Dr. Woolley, the responsible conductor of the experiment.

How the Experimenters

The experimenters at broadcasting station 2LO in London selected four subjects for the purpose of this test:

1. *A Japanese print of a human skull resting on the grass, with two birds;*
2. *A scented spray of white lilac;*
3. *Dr. Woolley himself, wearing a mask and a derby hat;*
4. *Two selections of playing cards.*

of material has been accumulated which seems likely to be of interest to normal experimental psychologists.

Coming to details, I would remind listeners that two of the five objects exhibited were playing cards, chosen by cutting a pack at random, so that no one had the slightest knowledge of what the card would be, a second before it was exhibited.

Under these circumstances the chance of successful guessing would be 1 in 52 or 53. Consequently out of the 25,320 results sent in, about 500 ought to have been successful.

The result was unexpected, and was not fully demonstrated by the first count; a recount was necessary, and has now been made. Listeners were unaware of the method of selection, and hence probably felt in favor of some of the more striking cards, and often guessed an ace or a court card rather than the more plebeian variety. The result, being unexpected, is of some psychological interest, as tending to show that mere chance does not rule such guesses. The ace of spades, for instance, was chosen by no fewer than 2,255 contributors in Test One, and by 1,636 in Test Four. And had it happened that the pack had been accidentally cut at the ace of spades, we might have fallen into the unfortunate trap of thinking that this measure of success was decidedly beyond chance. Even the ace of clubs was selected by 1,027 contributors in Test One. Other aces were in intermediate favor. Fortunately the card cut in Test One was not any one of the aces, but was the two of clubs, while in Test Four it was the nine of hearts, and in both these cases the numbers given were decidedly below what we might have expected by chance; *viz.*, only 199 in Test One, and 150 in Test Four, whereas in each case 500 would have been the chance expectation.

We must not draw any conclusion from the deficiency, any more than from the surplus, except this perfectly normal psychological conclusion, which becomes apparent on a study of the numbers:

(1) That telepathy had nothing to do with the result, and

(2) That the choice made by people when asked to name a card is not truly regulated by chance alone, but by some curious predilection—a predilection not only for aces, court cards and jokers (for the numbers giving the joker were 900 in Test One, 2,581 in Test Four), but for odd numbers in preference to even.

For, taking a rough average, the number of odd numbers selected had an average in their favor of about 400 each, while the even numbers selected had an average in favor of about 150 or 200 at most, sometimes falling below 100. This is a fact which may be a useful caution in applying the laws of chance.

Exhibit No. 2, which was stated to be "a picture," was actually a print of a skull in a Japanese garden, with two birds, one on the skull and one on the ground.

Exhibit No. 3, stated to be "an object," was a bunch of white lilacs. It is not possible to calculate numerical chances of success in such cases; nor, unless the numbers are overwhelming, would it be wise to assume the action of telepathy even in these cases. But I am inclined to think that an object like a skull gives a better chance to telepathic impression than a perfectly uninteresting object like a playing card. And, furthermore, once the picture of skull, garden, and birds has been shown to the agents, the impression would not evaporate at once, but would continue until something forcible displaced it. Moreover, a percipient, if he got any impression at all, might quite likely get it as a deferred impression, almost as likely to come out after the exhibit had been removed as at the time. If we were going to base any serious deduction on the results, this line of argument might be held in suspicion; but it has been previously suggested, as the result of private telepathic experiments, that an impression is often delayed, so that in analyzing the results this possibility ought not to be ignored.

It turns out that only four people definitely described Exhibit No. 2 as the picture of a skull, though one of them went so far as to say that it was a picture of a skull in a garden. But, oddly enough, for the next object, Exhibit No. 3, a skull was given by 714 listeners, while 1,036 gave flowers (which was correct); of this number 85 gave white scented flowers, though only three specified "white lilac," and 463 gave perfume.

It may be instructive to see if the idea of belated impression can be applied as far down the list as Exhibit No. 5, which

Called Upon Their Audience for Aid in the Tests

The experimenters concentrated their minds upon each subject, one at a time, and called upon their broadcast audience to do likewise—and to write down and send in descriptions of the mental images they received of the different subjects. Weeks were required to classify and analyze the flood of replies, which came not only from England and Europe, but from Australia and America. The results have been regarded as "partially successful." Later experiments, conducted from Station KFXB of Bell, California, are still being studied.

in reality was Dr. Woolley himself in a grotesque mask and bowler hat. For this object 523 gave flowers and 55 perfume. The only noticeable thing about those numbers is that they are decidedly smaller than those given for Exhibit No. 3, when flowers were the real object. The skull again seemed to persist, even down to Exhibit No. 5; for 166 recorded it in that case. The moderate amount of correct guessing for Exhibit No. 5 is given below.

Listeners were asked to record any emotion they felt in connection with the objects. Nine hundred and eighty-eight listeners recorded fear, horror, or detestation in connection with what we may suppose to be the skull. On the other hand in case of Exhibit No. 5, only 307 recorded those feelings, and 499 recorded amusement. Two hundred and two gave Exhibit No. 5 as a hat, 146 described it as one of the agents, while 236 said it was a person dressed up and masquerading—which it was. Whether it is wise to draw any deduction at all from these partial successes is very doubtful, and must be left for the present for more serious discussion hereafter.

It is of incidental interest to find that prominent and undoubted mediums, who good-naturedly took part in the test, were no more successful than any other members of the audience.

Meanwhile readers may be interested to hear of any striking individual successes that there may have been, however they choose to account for them. Among so great a number, I presume that one or two striking successes are inevitable. Here, then, is the record of one individual:

No. 1. Ace of clubs.
No. 2. Skull in garden.
No. 3. Flowers.
No. 4. Colored snap card.
No. 5. Some black object.

Of these, No. 4 is the only absolutely complete failure.

Again, a lady in Buckinghamshire, who gave Exhibit No. 1 as the joker, immediately corrected to the two of clubs, gave Exhibit No. 2 as "a cocoanut with a blue-tit upon it in Japanese print style." Seeing that the print was a Japanese garden, with birds in it and a round object, that amount of success is, at any rate, exceptional.

Another individual record gave Exhibit No. 2 as "a human head," and No. 3 as "flowers." Another gave for Exhibit No. 2 "Skull, very strong impression," and for Exhibit No. 3 "Bunch of blue flowers." Another gave for Exhibit No. 2 "a bird which became repulsive." And yet another "a picture of an awful-looking skull, which I clearly saw, and could not get rid of the whole at the time."

Finally, Dr. Woolley happened to detect, among the completely erroneous statements for Exhibit No. 5, an account of an incident which actually occurred, and which was thus described by the correspondent:

"Man pouring whisky into glass. Company present. Lady with dark hair and laughing face places restraining hand on the arm of the man pouring out the whisky."

How this could have been given as an attempt at what they were told was "an object," it is difficult to understand. But the episode quite certainly happened in the room, not at the time of the test, but immediately afterwards, and possibly while the record was being written. One of the Society's agents had thought that one of the two ladies present looked tired and faint, and was by her prevented from administering an alcoholic remedy—just as stated. The episode reminds one of some of Dr. Gilbert Murray's experiments in genuine telepathy, wherein he was able to describe in some detail an incident, historical or otherwise, which had been thought of by the company.

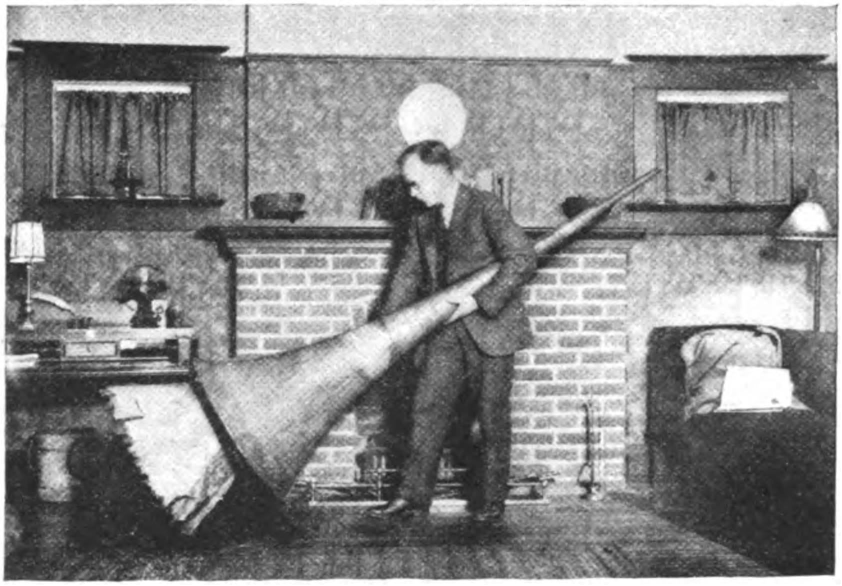
In conclusion, therefore, I would say that the results of the experiment are not unimportant from the point of view of experimental psychology. They do not confirm telepathy, neither do they deny it. They show that it is certainly not common and broadcast, but they leave open the possibility that a few individuals may have a percipient faculty more strongly developed than would be expected, and that their percipience may be delayed, and, as had been suspected before, that they may become aware of things present which were not intended to be transmitted to them.

Those who on *prima facie* grounds have made up their minds that telepathy is impossible will see in these sporadic results nothing but flukes and chance coincidence.

Those who are already convinced by evidence of the existence of a telepathic faculty under favorable conditions will

(*Continued on page 161*)

¶ *Here is a home-made unit that any experimenter of ordinary skill with tools may build for himself; it will add materially to the quality of broadcast reception.*



From a photograph made for POPULAR RADIO

A BIT UNWIELDLY—BUT WORTH THE SPACE IT OCCUPIES

The author of this article is shown here taking the completed horn off the framework upon which it was built, after the papier mâché has been allowed to dry and harden Note that the flare of the horn follows the same mathematical law as that which nature observes in shaping the morning glory or the snail shell.

HOW TO MAKE THE

Exponential Horn

Here are the constructional details of the latest and (what many experimenters consider) the best type of reproduction horn—a horn that gives extraordinarily truthful reproduction of both the high and low notes.

By W. F. SUTHERLAND

TO-DAY, with the rapid improvement of low-frequency amplifiers and the present standards of broadcasting high-quality transmission from the better broadcasting stations, there is an increasing demand for loudspeakers that will reproduce with equal efficiency all of the notes of the musical scale.

It is seldom that the experimental radio fan is able to do much work with the reproducers or loudspeakers themselves.

First of all, radio fans have been taught very little about the principles of the loudspeaker itself; secondly, they have had little information about the design of either the cone- or horn-type units.

At the present, popular sentiment seems to be in favor of the cone-type unit, although the horn type of loudspeaker may be able to reproduce and transmit broadcasting signals with excellent fidelity both on the high tones and low tones.

A reproducer does not amplify energy, strange as this may seem. It, together with the pressure chamber in front of the diaphragm of the reproducer unit, merely enables the diaphragm to obtain a grip on the air around it.

This is true of the horn-type loudspeaker. The horn is supposed to load the diaphragm and facilitate the useful conversion of energy to a vibrating air column. If this loading is not uniform for all frequencies, two effects will creep in—either a decrease in the amplitude of the sounds transmitted with decreasing frequency, or a predominance of certain notes over others, due to resonance.

The first of these effects—or, rather, defects—is present in the straight conical horn; it reproduces the low notes poorly or not at all. It reproduces the middle frequencies better and the high notes best of all.

This is a condition that is not to be desired, as the lower frequencies are the most difficult to bring through the reproducer, while within the higher frequencies of the audible range, the whines, whistles and other disturbing noises are usually easy to bring through.

The exponential horn, on the other hand, has the peculiar characteristic of radiating all frequencies uniformly down to a certain point below which no radiation takes place. This cut-off point is determined by the length of the horn; the longer the horn is, the lower are the frequencies that may be transmitted.

Figure 1 illustrates the two types of horns used in the reproduction of sound. The initial or straight-wall type has been assumed as starting at a diameter of 1 inch and increasing in diameter 1 inch for every 10 inches in length. The final diameter for a length of 40 inches would be only 5 inches.

The exponential horn, on the other hand, starts with the same initial size, but doubles its diameter every 10 inches with a final diameter of 16 inches.

It will be noticed that the growth of a horn of uniform taper is almost negligible, while the exponential horn, based on the law of organic growth, not only rapidly increases in size, but is a thing of beauty. It follows, indeed, the same laws as the size of the growing spiral of a snail shell. It increases according to the laws of compound interest. It also follows the same taper as the morning-glory flower.

The mathematician calls such a growth a "logarithmic" of growing, and if this range is expressed in the form of a curve the curve is called an "exponential curve"; whence we derive the name of the latest development in the art of reproducing signals—the exponential horn.

This article gives specific data for building at home a low-priced exponential horn that will reproduce broadcasting (when it is used with a good type of reproducing unit) probably better than any other form of sound chamber or loudspeaking unit.

Any radio experimenter can build the horn and get these results.

How to Determine the Shape of the Horn

The throat should be as small as is practicable. The smaller it is, the more uniform will be the action of the reproducer diaphragm. There is a lower limit, of course, to this size because of frictional losses; beyond that point the average response of the horn suffers and a loss of volume takes place. About 1/4 inch is as small as it is practicable to go and a diameter cf about 3/8 inch is a reasonable size, particularly as this closely approaches the net diameter of the aperture in an average reproducer unit.

The large end should be made as big as possible, as with the increase in size the end reflections—the cause of all air column resonances—are thrown to the bottom of the scale and are minimized. It is generally of no use to carry the horn much beyond the point where the sides form a 45-degree angle with the central axis. This point can be calculated easily, as will be shown later.

A small percentage increase makes for a more uniform response to all frequencies and lowers the cut-off point so that lower notes are more easily radiated. If the diameter at the mouth and the rate of growth are correctly determined, the resonant point of the mouth or opening will be thrown below the point of cut-off, and no resonance will occur.

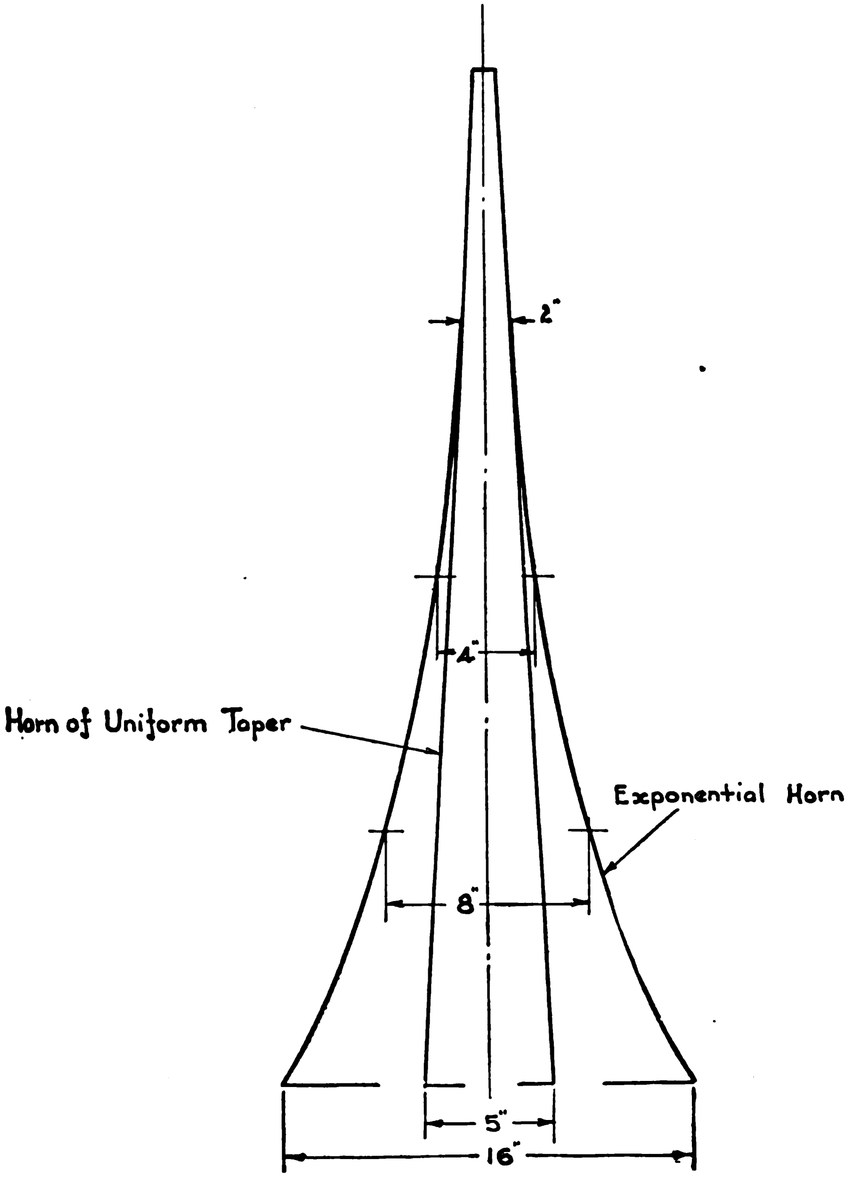
All of this makes for a long and large horn; practical expediency steps in with the limitations of house-room. Diameters ranging from 18 to 30 inches will be found satisfactory and rates of increase up to about 15 per cent per inch in length will also give excellent results without undue size.

The exact determination of the proportions for exponential horns is a matter that involves a certain skill in mathematics and physics that is beyond the scope of the average experimenter. This need not deter him from building such horns, however, as the aid of a few short-cuts and general rules will give surprisingly excellent results.

The term "percentage increase" may require a little explanation. Assume a small end diameter of 3/8 inch. This corresponds to an area of 0.11045 square inch. Assume also that we will let the horn grow at the rate of 10 per cent increase in area per inch in length. The area then at the end of the first inch will be $.11045 + .011045 = .12150$, and in tabular form for the ensuing inches of length as follows:

Distance along horn in inches	*Area in square inches*
Throat	.11045
1	.12150
2	.13365
3	.14700
4	.1617
5	.17787
6	.19565

This is rather a clumsy way of cal-



HOW THE OLD AND NEW HORNS COMPARE

FIGURE 1: *This drawing shows the difference between the older horn of uniform taper and the new exponential horn. Notice that the large end of the latter type has over three times the diameter of the more obsolete horn.*

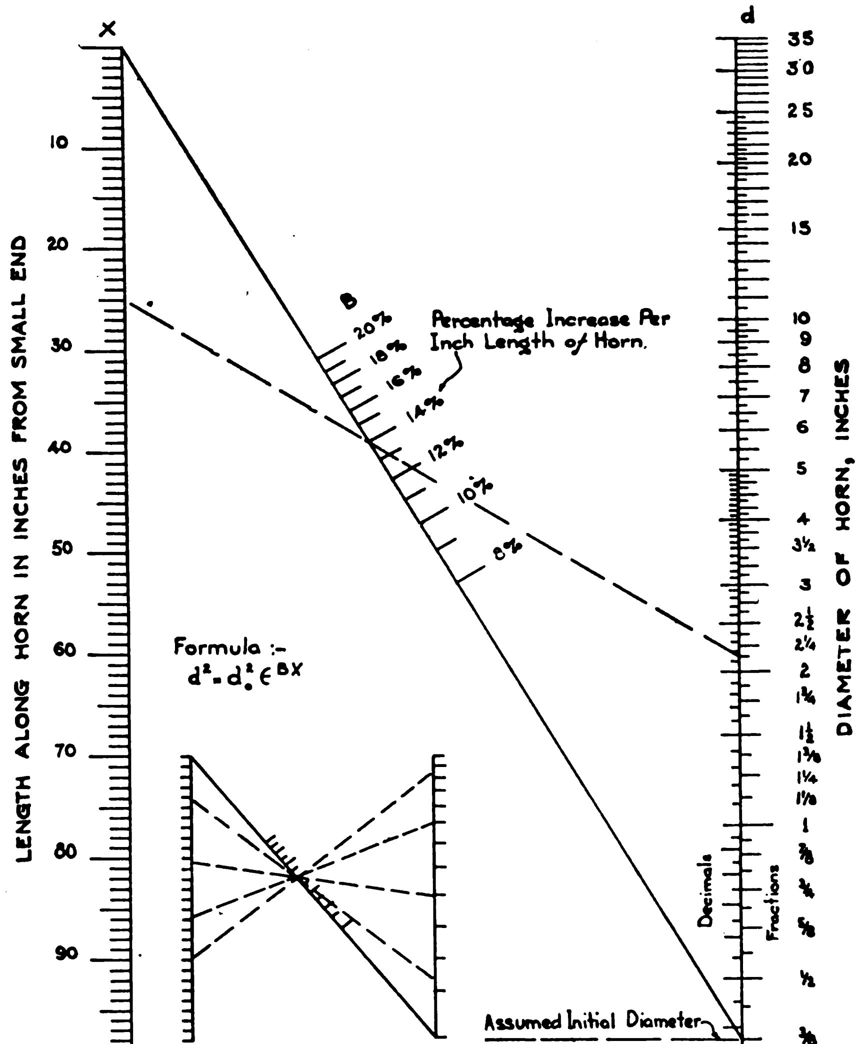
culating such a horn, and fortunately it is possible to construct a chart such as that shown in Figure 2, from which not only one horn, but any number and variety within reason, may be readily computed by the reader.

Three scales are shown. A scale marked *x* is seen on the left-hand side. This scale refers to the distance from the small end to any chosen point along the axis of the horn. The scale marked *d* gives diameters for various distances from the small end, while the scale *B* gives the percentage increase in area per inch of horn length, and is used in conjunction with the other two in the following manner:

Suppose, for example, that it is desired to lay out a horn that has an increase of 14 per cent per inch, starting from an initial diameter of ⅜ inch. A ruler is procured and laid on the chart. Starting at the small end, a line is drawn from the 10-inch point on the *x* scale through the 14 per cent point on the *B* scale. The point is noted where it cuts the *d* scale. This point gives the diameter at 10 inches from the small end. Similarly lines are drown for other distances and the results are tabulated.

Note on the chart that a dotted line has been drawn from the point, $x = 25$ inches, through the 14 per cent increase point on the *B* scale. This line cuts the *d* scale at the diameter 2⅛ inches. This line is typical for all others. When the lines are drawn in pencil, the chart will have the appearance shown in the bottom left-hand corner.

Instead of a ruler and pencil, a thread stretched tightly may be used, or, better still, a piece of transparent celluloid with a line scratched on it.



THE CHART THAT HELPS TO DETERMINE THE DIMENSIONS OF THE HORN

FIGURE 2: *From this alignment diagram the experimenter may determine, with the aid of a ruler, the exact dimensions for making any type of exponential horn he wants. The use of the chart is explained in detail in the text.*

As an example, take the 14 per cent increase horn and determine the size all along its length. The following results will be obtained:

Distance X along horn from small end	*Diameter at Distance X from small end*
10	¾
20	1½
30	3 1/16
40	6⅛
45	8⅞
50	12½
55	17½
60	24½
65	35

It will be noticed in Figure 2 that all horns start at a small end diameter of ⅜ inch. This is about as small as one can go for proper acoustics and anything larger can be obtained by eliminating such of the small end as may be necessary to bring it up to the proper size.

As stated before, there is little gained by making the large end of the horn of greater flare than 45 degrees. The constructor may easily determine for himself just what diameter corresponds to this point by remembering that a diameter equal to four divided by the percentage-increase, per inch, gives this angle. Thus for the 14 per cent increase the diameter corresponding to a 45-degree flare at the mouth will equal:

$$4 \div \frac{14}{100} = 28\frac{1}{2} \text{ inches approximately.}$$

How to Make the Form

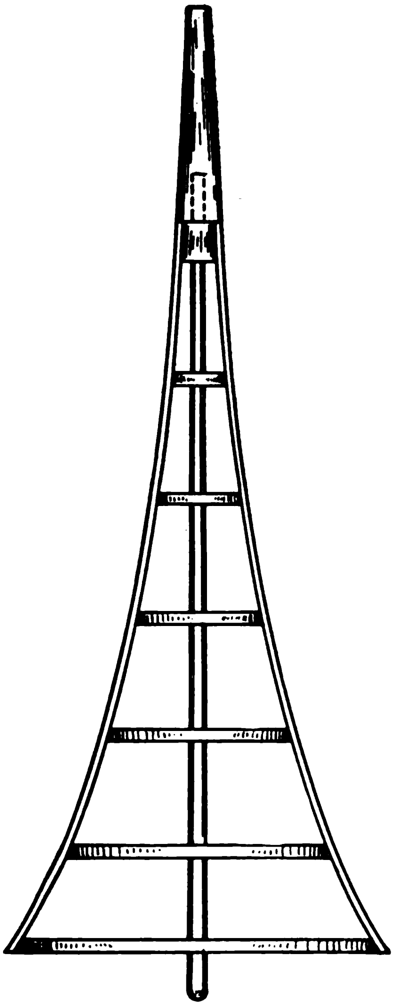
A form must first be constructed. A long, wooden rod the size of a broomstick should first be procured. This forms the backbone of the form.

Wooden discs cut out of ½- or ¾-inch stuff are next to be strung on it. These discs should be spaced from 9 to 12 inches apart and should be somewhat smaller than the horn will be at their several locations, to allow for the wooden strips to be nailed on the outside. These strips may be of any convenient thickness (say, ⅛ inch), and should not be over ¾ inch wide. They and the discs cut to the proper size may be procured at the local planing mill.

Four strips are to be nailed on the discs at equi-distant points around the circumference. These serve to hold everything in place. When the form is thus lined up, it may be covered with similar strips nailed to every disc and enclosing the whole surface.

The small end of the horn requires special attention. Our broomstick in itself will be far too large for the small end and the securing of the proper taper by means of circular discs is out of the question, owing to the small diameter.

This difficulty is overcome as shown



THE MOULDING FRAME

FIGURE 3: *The local planing mill will probably have to be called into service in making the wooden discs, but the frame may be easily built up at home by anyone of ordinary proficiency with tools.*

in Figure 3. A piece of wood of the right size and taper is turned up. A hole is bored in the end to admit the broomstick and a shoulder is also turned on the same end, so that such of the exterior lagging strips as reach that far may lie flat with the surface of the turned hub.

How to Build the Horn

Papier mâché is an excellent material for the home-builder to use in constructing the horn. It is hard, light, and when thoroughly dry stands up under a tremendous amount of abuse. It is made of two simple ingredients that are always available, paper and wheat flour paste.

"Stickfast" paste, a commercial preparation, can also be used with excellent results. A little glue may be added if desired, but the flour paste in itself gives an extremely hard composition, requiring the use of a wood saw for its cutting.

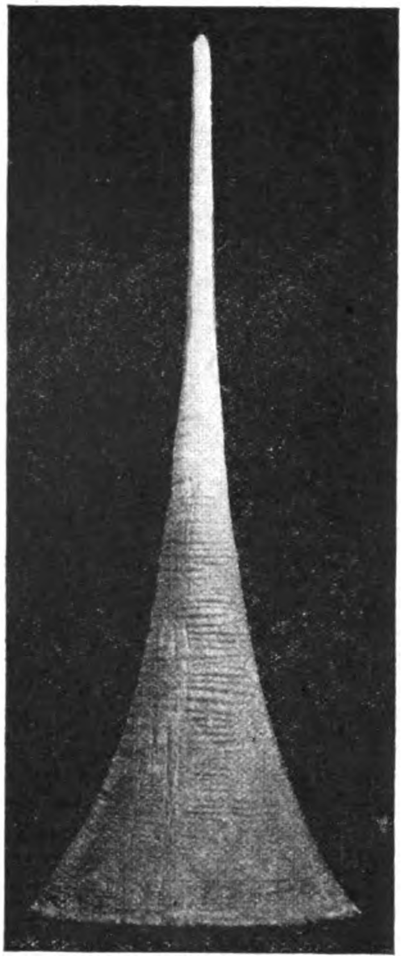
The following procedure is preferably adopted:

After the form is made as described above, it is covered with several layers of newspapers tightly shellacked down. About two more layers are next put on, lightly held in place by a daub of mucilage here and there. Outside the layer of newspapers is placed one or two layers of waxed paper, well greased with "Alemite" or other cup grease. The purpose of this paper on the form is to prevent the sticking of the horn to the form when it dries.

The horn proper is now begun. A roll of building paper is procured and a sufficient amount is cut off to make about four layers deep on the form. The paper is cut into pieces about a foot square. Enough for the first layer is soaked in hot water just long enough for it to become pliable. This first layer contains no paste and must be well lapped in order that the paste from the succeeding layers may not run through. The remaining layers (about three) are next laid on, one after another. Have handy a good-sized kettle full of fairly thick paste. Keep this kettleful hot. Soak the paper directly in the paste and apply it with the hands. Use plenty of paste; it will dry out.

When the horn is complete, it will be found advantageous to apply a wrapping of heavy string, at about 1-inch pitch, for the full length of the horn, starting at the small end. This serves to hold all together while drying. Stand it in a warm, dry place, preferably near the furnace, and allow it to dry for at least three or four days before attempting to remove it from the form. As the drying progresses, it will be noticed that the horn shrinks slightly and becomes hard to the touch.

On removal from the form, allow the horn to dry still further and then give it several coats of shellac inside and out. It may be found necessary also to tack down some loose corners on the inside with liquid glue.



READY FOR THE SHELLAC

FIGURE 4: *Before the horn is given its final coating of shellac, inside and outside, it may be painted with a color that will make it harmonize with the color scheme of the room where it will be installed.*

A ring of No. 4 copper or iron wire slipped down over the wet horn to the mouth will be found to reinforce it in a most satisfactory manner. The wet paper may be lapped up over the ring; this holds it in place and gives a neat appearance.

Of course, to make a complete job of the unit, a good-quality reproducer unit should be fastened tightly at the small end of the horn.

New Constructional Articles for Next Month

The October issue of POPULAR RADIO *will contain full constructional data on two new receivers, each of which embodies new theories in radio reception and fills a distinct need—the Magnaformer 9-8 Loop Receiver and the LC-28 Receiver. These constructional articles will be followed by articles on operation which will enable the fan and experimenter to realize every possibility in the receivers.*

J. Alden Weeks

ADVENTURES IN THE AIR

Dramatic, amusing and sometimes tragic experiences befall both the radio reception fan as well as the transmitting amateur and the professional operator. What strange experiences with radio have *you* had? POPULAR RADIO will pay one cent a word for true stories of strange incidents—preferably told in the first person.

I Help Capture a Crook by Radio

While I was serving as the radio operator aboard the *S. S. Columbus* (WFJ), plying between Chicago and Milwaukee, a passenger rushed up to the radio cabin one afternoon and informed me that he had recognized in a deckhand a man for whom the police were looking. He explained to me that this man's business was to obtain employment in stores, learn the layout and location of the valuables and then, with the help of his pals, burglarize the place. The passenger told me that the suspect had jumped his bond and shipped as a member of our crew, apparently with the hope of evading the authorities.

My informant had had dealings with this man before and knew that the fugitive had a grudge against him; consequently he was very careful to keep out of the deckhand's sight.

I sent the passenger to the captain of the ship. For a time the captain was undecided as to whether or not he should lock the deckhand up to keep him from jumping ashore when we reached the dock. If the deckhand proved to be innocent he would of course have legal recourse against the captain, if taken into custody; if left free he might escape or might injure the passenger.

The captain finally wrote out the following message to the Milwaukee Police:

"MEMBER SHIP'S CREW WANTED BY CHICAGO POLICE. ARRIVE MILWAUKEE 2:30 P. M. ENTER FORWARD GANG PLANK."

I transmitted the message immediately.

Upon our arrival at the dock, two detectives forced their way aboard ship before the passengers were let off. The deckhand was at that time busy helping to make fast the stern line to the dock; he was taken by surprise when the officers showed their badges.

The last I saw of him was as he walked along the dock between the two detectives.

—C. H. Zeller, *Chicago, Illinois.*

* *

A Transmission Test that Sounded a False Alarm

"Be carerul what you say to 'Mike,'" is the warning issued to its radio experimenters by the Air Service of the War Department.

This warning was the result of an amusing incident that occurred during the testing out of a radio sending set at McCook Field, Dayton, Ohio. Lieut. Lowell Johnson was the pilot and Mr. Studebaker, in the rear seat, was sending a constant, mellifluous vocal stream into the transmitter microphone. The stream of conversations is designed to be constant, as the checker on the ground cannot interpret silence, for there is no difference between the brand of silence that comes when the set is out of order and the brand that is intentional. After announcing "McCook Field Airplane, P-292," Mr. Studebaker had been valiantly reciting number series, words and phrases until his stock became exhausted; then he began to sing:

"London Bridge is falling down,
Falling down, falling down—"

Presently in the radio laboratory the telephone rang; a feminine voice was at the other end of the line.

"Is this McCook Field?" it asked. And being assured affirmatively, the voice went on:

"I have a very good radio set and I have just gotten in touch with one of your airplanes. There's a man in it who seems to be in distress; he keeps calling out that he's falling down. I thought you might want to send up another plane to help him."

The lady was thanked solemnly for her solicitude—but the story went the rounds of the McCook Field like wildfire.

Since then the radio experimenters have been extremely careful about what they say into Mike.

—S. R. Winters, *Washington, D. C.*

My Uncanny Experience with "Radio Spooks"

About eight years ago I had a pet crystal set in my home, which I used for code practice; of course, there were no broadcasting stations in operation at the time. It was rigged up in the dining room, and to the receiver unit I had cemented a paper horn. With it I could hear the local high-powered code stations (particularly NAH, the Navy Yard) all over the apartment, and with sufficient intensity for accurate copying, especially at night.

Everything went normally for a few months—and then things took a turn.

I had established the habit of leaving the set connected and tuned after I had finished an evening's listening. One night I was awakened by an extra loud volley of code characters, hurled from NAH. It was so loud and promised to continue for so long that I got up and shut off the set. A few nights later I was again abruptly awakened by a violent "da-dit-da dit-dit-dit-dit," followed by a long spasm of code, alternating in fast and slow measure.

Again I got up to turn it off; but to my amazement, *the switch was already off!* And upon putting my ear to the horn, the signals were apparently of no greater intensity than when I moved away from it!

After that, it was a common occurrence to awaken in the middle of the night and hear the rhythmic code signals shrieking away at full blast; even at times in broad daylight did this annoying phenomenon manifest itself. Unfortunately I was never a code fiend, and I never even tried to copy any of the messages; perhaps if I had they would have disappeared, as is the habit of dreams which we try to scrutinize more vividly. However, I can affirm that they were of the identical character of *bona fide* messages, for although I was never an expert operator, I had an operator's ability of "sensing" a character foreign to the regular radio alphabet.

An explanation of this extraordinary phenomenon cannot be more than a guess. Some might say that a direct impression was made upon the mind by radio waves, utilizing the sensitive and intricate mental apparatus much in the same manner as a receiving set. How this could be accomplished is beyond present comprehension; it may be possible, though it is highly improbable.

Having a telepathic consciousness, or hearing telepathically either the audible code sounds or their counterpart in the mind of an operator, would be a second hypothesis. This, too, is doubtful, although possible.

What I believe to be the true cause (in my particular case, at least) comes from within. It was probably a manifestation of subconscious impressions that had been stored up previously, and the nature was purely hallucinary. However, it was as perfectly real and obvious to me as I suppose are the horrible phantasms to an inebriate afflicted with the delirium tremens.

From whatever source such supernormal signals may come, they are nothing to worry over. I lost mine shortly after discontinuing the study of the code.

—Malcolm St. Denis, *Brooklyn, N. Y.*

* *

I Pick Up a Distress Call from an Unknown Ship

Suppose you were a radio operator sitting at the instruments, listening to the tangle of the ether traffic and wondering how much longer it would be before your relief came, and then suddenly, so faintly that you could hardly read it, you heard a distant ship calling frantically for help.

That was an experience that happened to me; indeed, I listened to all the details of the rescue. But I have never found out what ship it was. Can any of our readers help me out?

It was during the evening watch on December 6th, 1922. I was on duty at a Great Lakes shore station. I listened in on the bedlam of all the shipping and the crash of the freaking Atlantic stations, wondering if my eardrums would stand all the racket until midnight brought my relief.

And then suddenly a new note came in; it was the booming voice of WCY commanding all the stations to QRT, (stop transmitting).

WSA and WNY gave out the same command.

Quickly starting the motors, I silenced the lake shipping.

Then I switched on my receiver and listened again.

At first I heard nothing, but as the interference subsided, something began to come in. The dots and dashes were almost inaudible, but I managed to make out:

"North latitude 38 degrees, 31 minutes; West longitude 62 degrees, 12 minutes. Hatches . . ."

The sentence faded in the middle. That was all I could hear.

I tuned hastily to a slightly higher wavelength.

Silence.

I tuned to a lower wavelength. A violin wailed and a piano tinkled.

Then the telephone rang and I jumped to it. But it was the wrong number—"excuse it, please!"

By the time I got back to the instruments the signals began to come in again, but so faintly that I could not make them out at all. I wondered if anyone could read them. Judging from the first message, I surmised that the ships hatches were smashed in by the heavy seas. I thought of the poor fellows out at sea in the gale, and how they must be wondering if anyone would get to their rescue in time. The signals were still too weak for me to hear, but I thought I heard the operator sign DHK. What would happen to him?

After nearly an hour the note of WCY boomed out again. Help was on its way, it announced. Another ship was nearing them.

The lake traffic began to come in again. The ether began to fill up with sound again.

I wiped my face with my handkerchief. I never was able to find out what ship it was, but at the time I felt as relieved as if I had been rescued myself.

—T. C. Van Alstyne.

* *

I Deliver a Broadcast Death-Message

One time, while I was listening in on my single tube set, I heard the announcer make this peremptory demand upon all of his listeners:

"Every listener who is interested get a pencil and paper immediately. Ready to write? All right:

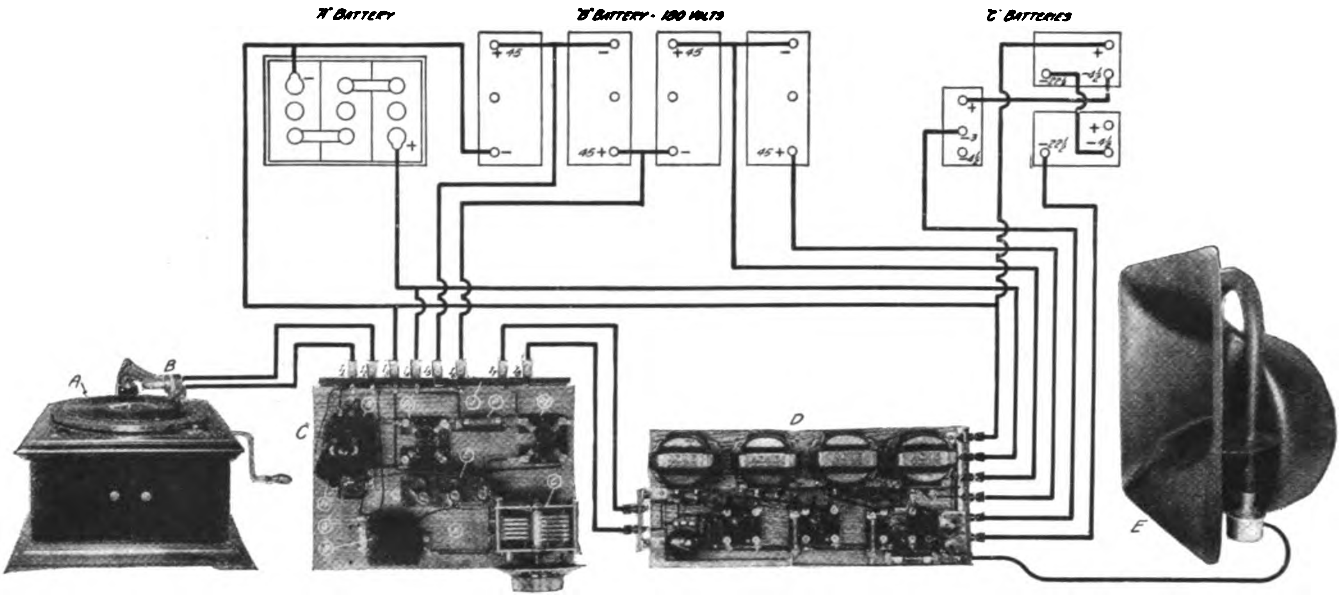
"John Redding of this city (Indianapolis) died at two o'clock this evening. John Redding's brother and wife and mother started for Florida at one o'clock. Please stop them by this method of instruction. They are going by the Michigan state road, through Greensburg, Madison, and Cincinnati.

"They are in a 1922 Buick touring car, license No. 340042, Ind., '22. Name, Myron Redding. Three people in car. The car has two extra tires behind."

With this information I set out for the Michigan road, which was about a quarter mile from my place. I watched for twenty-five minutes, but no auto that conformed to the broadcast description came by. About three o'clock I saw a Buick coming and stopped him, but it was not the wanted car. In about ten minutes another car came along and this proved to be the right one. I sent the occupants to Adams, Indiana, a nearby town, where they called up their relatives in Indianapolis and reported that they were coming back right away.

The next day I got a check for $5.00.

—B. F. Bower, *Greensburg, Ind.*



A MATCHED COMBINATION OF UNITS THAT PROVIDES EXCELLENT REPRODUCTION

FIGURE 1: *The pick-up unit, B, is of the condenser type; it is fully described in this article. The amplifier, D, is of the impedance-coupled type; it employs two UX-201-a type valves, with a UX-171 type valve in the last stage. It was described in the September, 1926, issue of* POPULAR RADIO. *The oscillator-detector unit, C, is described below.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any old phonograph;
B—El-fonic pick-up unit, capacity type;
C—Oscillator-detector unit;
D—Quality amplifier described in September, 1926, issue of POPULAR RADIO;
E—Racon spiral horn.

HERE IS A LIST OF PARTS THAT YOU WILL REQUIRE FOR THE OSCILLATOR DETECTOR UNIT—

A—Camfield coupling unit;
B—Benjamin high-frequency transformer;
C—Cardwell variable condenser, type E, capacity .0005 mfd.;
D1 and D2—Airgap sockets;
E—Burgess "C" battery, type 2370, 4½ volts;
F—Elkay Equalizer, type 2 (½ ampere);
G—Aerovox fixed condenser, .00025 mfd.;
H—Aerovox fixed condenser, .006 mfd.;
I1, I2, I3, I4, I5, I6, I7 and I8—X-L push type binding posts;
J—Composition binding-post strip, 11½ by 1½ by ¼ inch;
K—Hardwood baseboard, 12 by 8¾ inches.

HOW TO ADD TO YOUR OLD PHONOGRAPH

A New Amplification Unit

NO. 2 of the series of articles on the new "electrical pick-up" devices that convert your old talking-machine into a reproducing instrument of a quality never before attainable.

If you already have a radio receiver and a phonograph (any type with a turn-table in running order will serve), all the new apparatus you need for hooking them up together is the newly developed electrical pick-up device that costs from $10 to $20; if you *don't* own a receiver, the same effects may be attained through a reproducer and amplifier—which will cost altogether from $40 up to $125. Demonstrations have shown that this invention gives better reproduction than has ever before been attainable.

By RAYMOND FRANCIS YATES

IN the July issue of POPULAR RADIO it was shown how easily and inexpensively an old talking-machine could be converted into an ultra-modern device that will produce music from records with the same remarkable clarity of reproduction as could formerly be obtained only with high-priced radio receivers.

In that issue it was shown that the phonograph, thus brought up to date and rejuvenated with the aid of new radio apparatus, is a distinct adjunct to any radio receiver and one that can bring a much greater range of enjoyment to the broadcast fan and the music lover. All that is necessary to make this change on your old phonograph—or new one, for that matter—is an electrical "pick-up" device, a power amplifier and a good reproducer.

Four arrangements of units for accomplishing these results were described in detail in the July issue.

The importance of the correct "matching" of the three elements—the pick-up device, the amplifier and the reproducer—was emphasized. All four of the combinations described in the July issue dealt with the type of pick-up device known as the *electromagnetic* type.

This second article on the subject takes up the *electrostatic* or *condenser* type of electrical pick-up.

In Figure 1 is shown the combination of a condenser pick-up with a simple oscillator, consisting of a single valve, coupled to a detector valve, exactly as used in a radio set.

The detector in this outfit is used to "rectify" the modulated electrical energy taken from the oscillator valve; it is coupled, in turn, to an impedance-coupled amplifier that was described in detail in the September, 1926, issue of POPULAR RADIO. The output of this amplifier is then connected to a large Racon exponential horn.

In Figure 2 is shown the general construction of the condenser type of electrical pick-up; the method of its functioning is outlined in the caption.

The unit, C, in Figure 1, may be easily built of standard radio parts and at low expense. The results obtained will be found worthwhile.

How to Make the Oscillator-Detector Unit

Figure 3 is a schematic diagram of the circuit of the oscillator-detector unit. The instruments used are to be fastened down to the baseboard with wood screws according to the general layout shown in Figure 1; if all of the parts are connected as shown in Figure 3, the unit will be ready for use as soon as the valves are put in place.

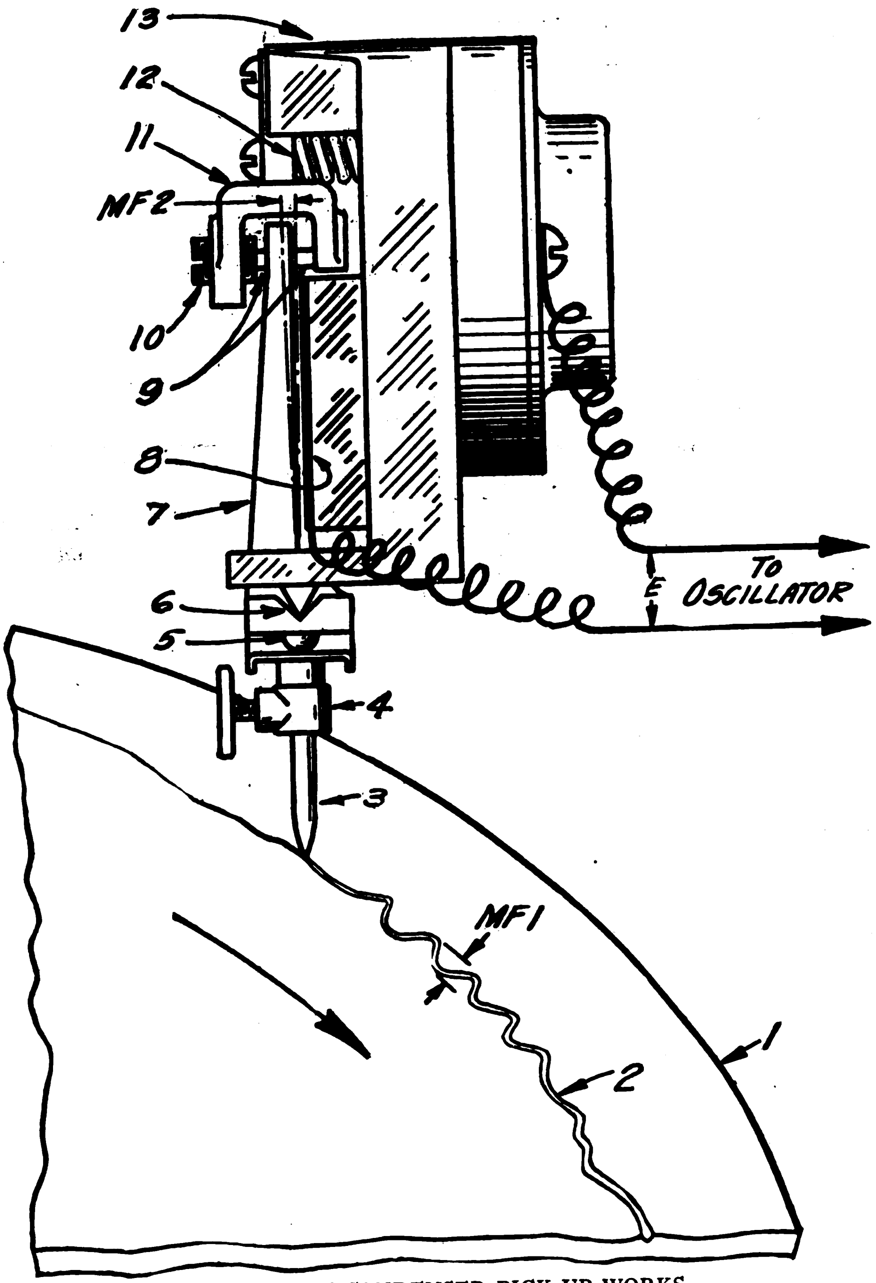
The two valves in the oscillator-detector unit, C, should be standard UX-201-a type valves. The first two valves at the left in the amplifier unit, D, are UX-201-a type valves, and the last valve, the one at the extreme right, may be a UX-171 type valve.

If this combination is to be mounted inside of the console of an old type phonograph, a single-pole, single-throw knife switch may be inserted in the "A" battery circuit to turn on the valves and put the set in operation.

When the unit is ready for operation this switch is closed and the variable condenser of the oscillator-detector unit should be rotated and set at the position where the loudest clicking noise will be heard in the loudspeaker, E, when the needle on the pick-up device is plucked with the finger. This condenser should then be left set in this position at all times. The volume of reproduction will be controlled by rotating the small knob on the coupling coil of the oscillator-detector unit.

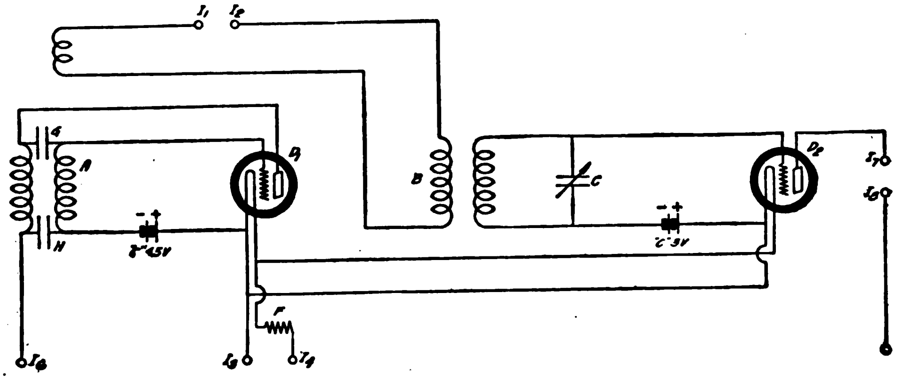
The quality of reproduction that may be obtained from the new electrically recorded records with this combination should please even the most critical ear.

In Figure 4 is shown a matched combination of units incorporating an electromagnetic pick-up device that was described in the preceding instal-



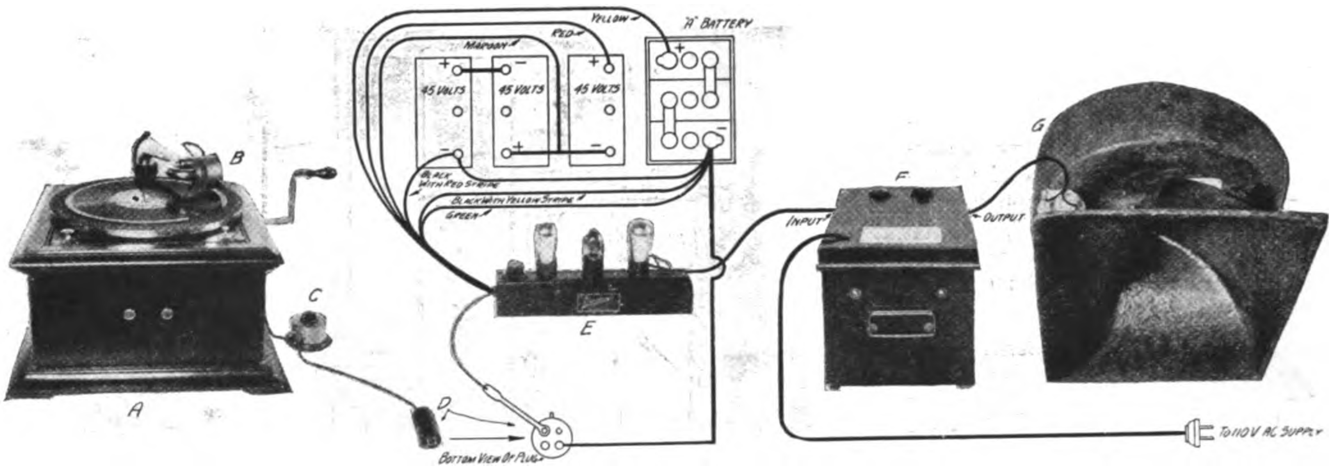
HOW THE CONDENSER PICK-UP WORKS

FIGURE 2: *The needle, 3, to which is attached the vibrating armature, 7, follows the vibrations, 2, imprinted on the record, 1. The vibration of the armature causes corresponding variations in the distance between its inner surface and the insulated metal surface, 8, of the fixed portion of the unit. These two surfaces serve as the two plates of a condenser, the capacity of which varies with the vibration of the armature. When the pick-up is connected to the oscillator-detector unit, this capacity variation modulates the oscillator output. The detector "rectifies" this modulated current, with the result that the detector output is an exact electrical reproduction of the recorded music or speech.*



SCHEMATIC DIAGRAM OF THE OSCILLATOR-DETECTOR

FIGURE 3: *The electrical details of the oscillator-detector unit, C, of Figure 1, are given here. The designating letters correspond with those in the list of parts at the head of the article.*



A MATCHED COMBINATION THAT EMPLOYS AN ADDITIONAL STAGE OF HIGH-POWER AMPLIFICATION

FIGURE 4: *This combination uses a standard "Truphonic" amplifier, followed by one stage of power amplification that employs a 210-type power valve to produce extreme volume without distortion in the quality of reproduction.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

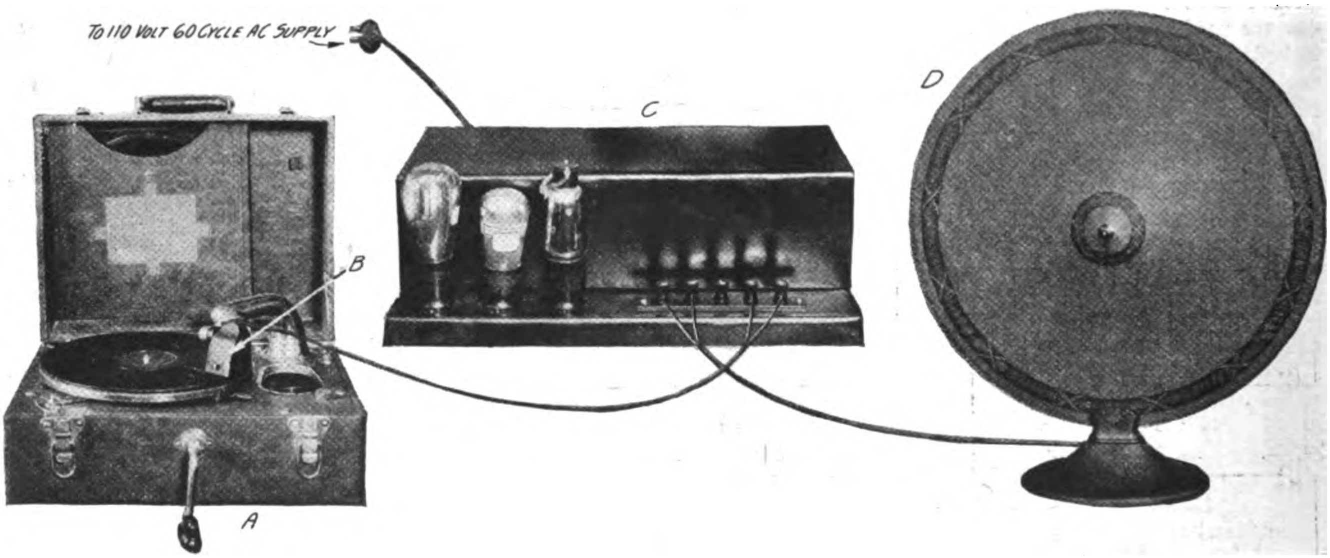
A—Any phonograph;
B, C and D—Warford reproducer, comprising pick-up, control unit and plug;
E—Truphonic amplifier No. 304, comprising three stages of low-frequency amplification;
F—Warford single-stage power amplifier that operates from the AC line;
G—Newcomb-Hawley reproducer.

ment of this series. In it will be found the pick-up device, B, volume control, C, a connection plug, D, amplifier, E, to which has been added a high-power stage of amplification, F, working from the alternating-current lighting lines.

A combination such as this gives a surprising amount of volume without distortion—in fact, enough to operate a number of exponential type horns for a large hall or auditorium. This combination has been found exceptionally well suited for use in public schools, dance halls, clubs, restaurants and other amusement places for supplanting the orchestra.

Another combination of an electrical pick-up unit in which all of the apparatus has been matched to produce the best tone quality is shown in Figure 5. This consists of the pick-up unit, B, an AC operated amplifier, C, that employs one 213-B type rectifier valve, a McCullough AC valve in the first stage of transformer-coupled amplification and a UX-171 type valve for supplying the power to the last stage of transformer-coupled amplification. This combination works entirely without batteries and is exceptionally well suited to home use.

Figure 6 shows a complete radio receiver that has recently been placed on the market incorporating "battery-less" operation with reproduction from either radio broadcasting or a phonograph pick-up. The set uses high-power rectifier valves of the UX-216-b type with a series of UX-199 type valves followed by a UX-210 type valve in the last stage of low-frequency amplification. No batteries are necessary with

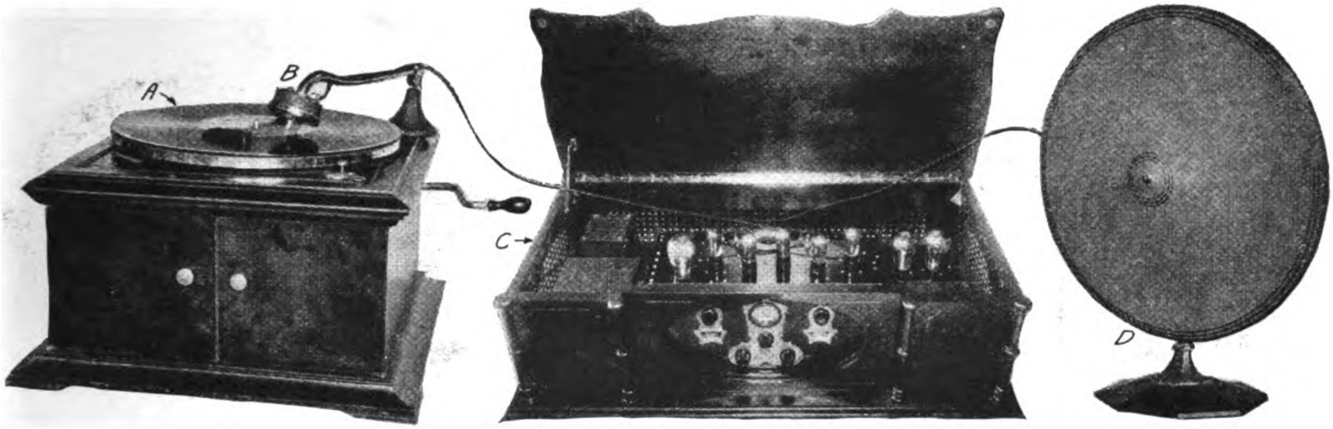


A MATCHED COMBINATION THAT OPERATES WITHOUT BATTERIES

FIGURE 5: *This group may be readily moved around to any location where an AC line socket is available, and the quality of its reproduction is excellent.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any phonograph (portable type shown);
B—Pacent Phonovox electrical pick-up;
C—Pacent two-stage AC amplifier;
D—Pacent 18-inch standard cone-type reproducer.



A COMBINATION WHICH REPRODUCES EITHER RADIO OR PHONOGRAPH PROGRAMS

FIGURE 6: *The radio receiver shown above draws its operating power from the light lines and contains a high-grade low-frequency amplifier. It requires only the push of a switch to change over from radio reproduction to phonograph reproduction.*

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES THAT YOU WILL REQUIRE FOR THE ABOVE UNIT—

A—Any phonograph;
B—Argus pick-up unit;
C—Argus power radio, Model B-195;
D—Western Electric 540-AW cone-type reproducer.

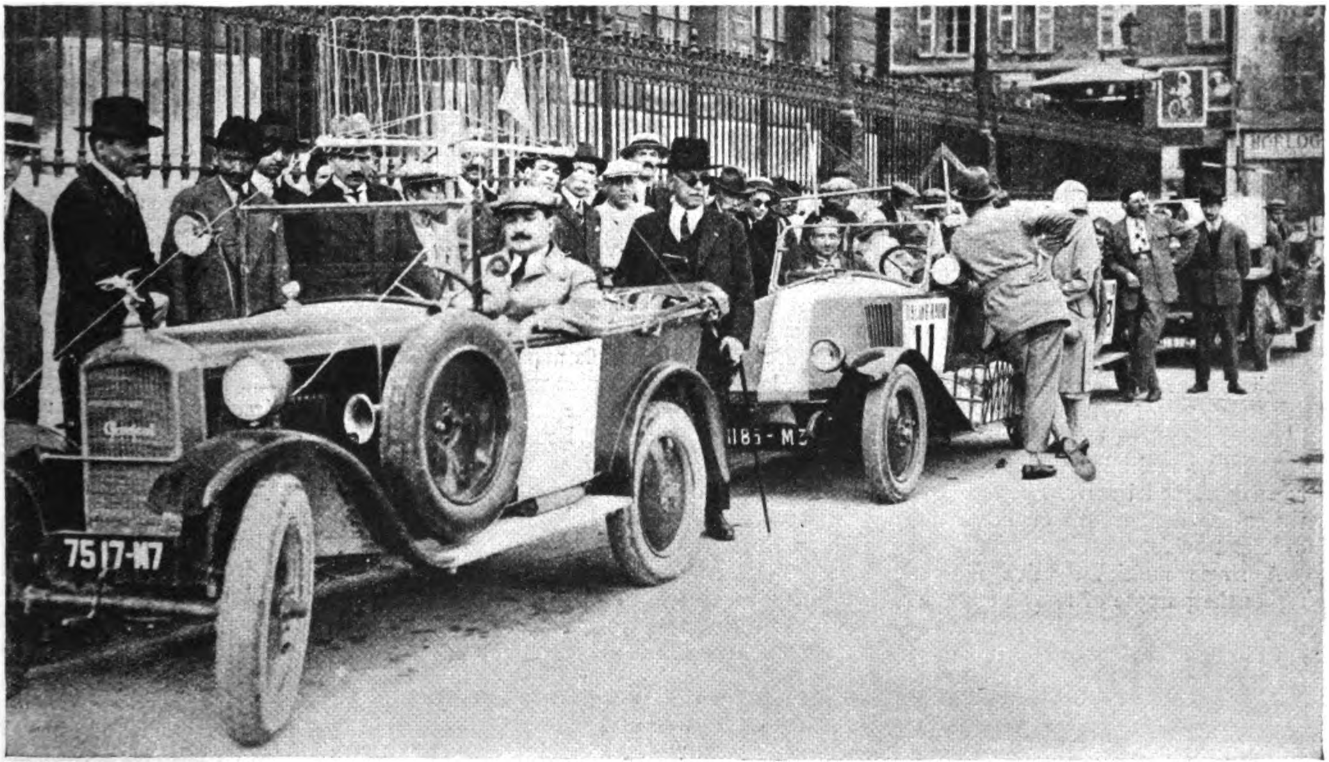
this receiver; it operates entirely from the 110-volt, 60 cycle AC lighting lines. A plug is furnished to connect to the house current, and the only other connection necessary is to an antenna. The set may be used to receive radio broadcasting by pushing "down" a small push switch at the rear of the set and may be used for phonograph reproduction by pulling "up" the same switch.

An electromagnetic pick-up device is furnished as part of the equipment and will work with any type of phonograph.

There are many music fans who have been reluctant to get rid of their old phonographs, vaguely hoping that at some time they may be useful. This new development enables any one to make a new instrument out of this old machine, with highly satisfactory results.

Another great advantage that can be obtained with the use of the same amplifiers, described in this and preceding articles, is the improvement of an old radio set. The amplifiers themselves may be incorporated as part of the radio set, to work with either the phonograph or broadcasting.

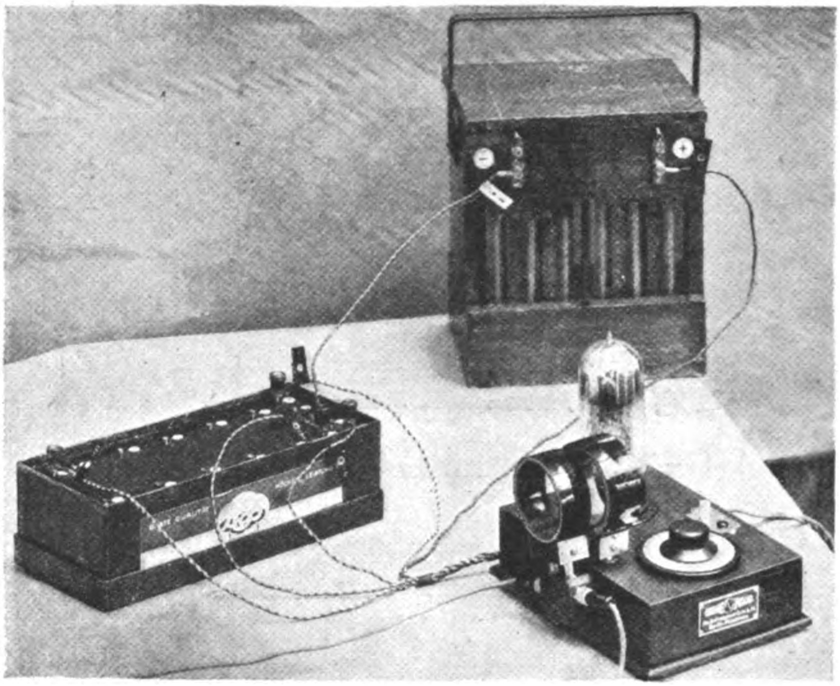
In following articles this phase of improvement will be described.



Delano

A RADIO AUTO MEET BRINGS FORTH UNUSUAL SET DESIGNS

Here are some of the contestants in a meet that auto owning radio fans recently held in Marseilles. Experimenters from all parts of France participated.



A SIMPLE SET-UP FOR A TRIPLEX VALVE

FIGURE 1: *At the lower right is shown the receiver itself, with the two tuning coils, the single variable condenser and the triplex valve mounted on the top. At the left are shown the "B" batteries in a block, and in the background is shown a portable "A" battery.*

The New "Multiplex Valves"

What They Mean to the Experimenter and to the Listener

This article, which tells of some of the new vacuum valves developed by Dr. Loewe and the author, both eminent German scientists, gives the experimenter some data that opens new lines of research and stimulates ideas well worth developing.

By MANFRED VON ARDENNE

EVERY set builder knows how much of the time that he takes in building radio receivers is spent in making the wiring connections between the various stages of high- and low-frequency amplification. In sets that employ a large number of valves this wiring job becomes a tedious business.

The new multiplex valves that have been developed by Dr. Loewe and the writer are designed to eliminate much of this trouble.

A single multiplex valve not only serves the purpose of two or more ordinary valves, but it also includes the coupling devices needed to provide interstage coupling between these valves.

In other words, one of these multiplex valves may be used as a complete amplifier in itself.

Furthermore, the multiplex valves accomplish this amplification in receiving-set construction without imposing undue limitations as to the variations in the circuits.

Just glance, for example, at the accompanying diagrams.

Figure 6 shows a simple arrangement with a low-frequency triplex valve; this hook-up is suitable for reception of the more powerful stations. For ordinary reception of the local stations on a cone- or horn-type reproducer, a small indoor or loop antenna should be sufficient. Should the reception of distant stations be desired, an outdoor antenna and a low-loss tuner are essential.

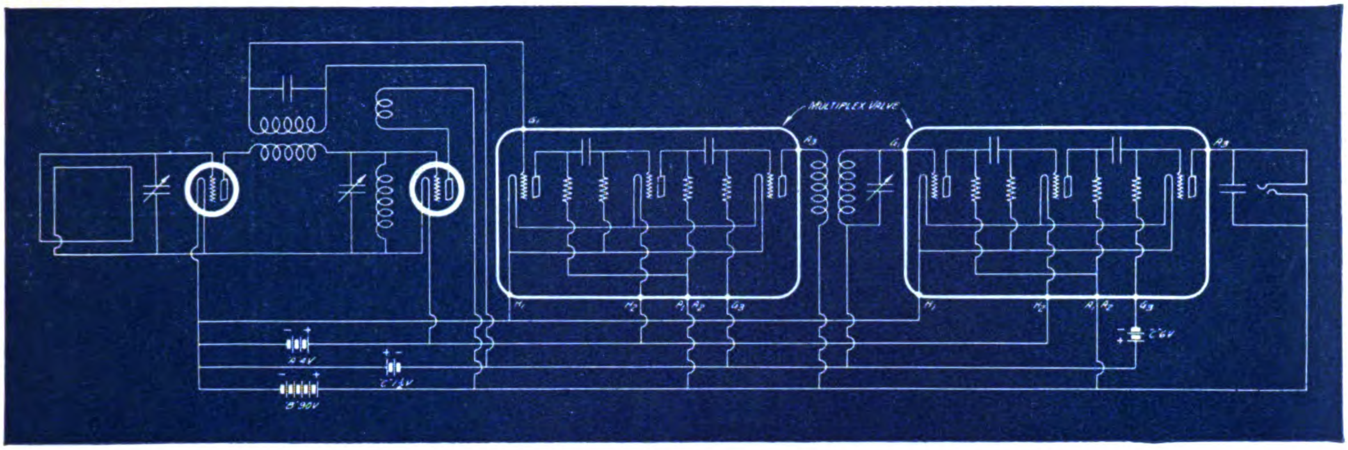
Rectification takes place in the first stage. This rectifying effect is dependent on the impedance of the capacity (stray or otherwise) that is included in the anode circuit. It is only obtained satisfactorily when this impedance is low; that is, at high frequencies. The amplification constant is between 20 and 30. Filament resistances are not necessary with these multiplex systems, as the filaments are correctly dimensioned for a 4-volt battery.

Figure 1 shows a view of a receiver that embodies the circuit shown in Figure 6.

Another circuit, much to be recommended, employs two ordinary valves as high-frequency amplifiers and one low-frequency triplex valve (shown in Figure 4).

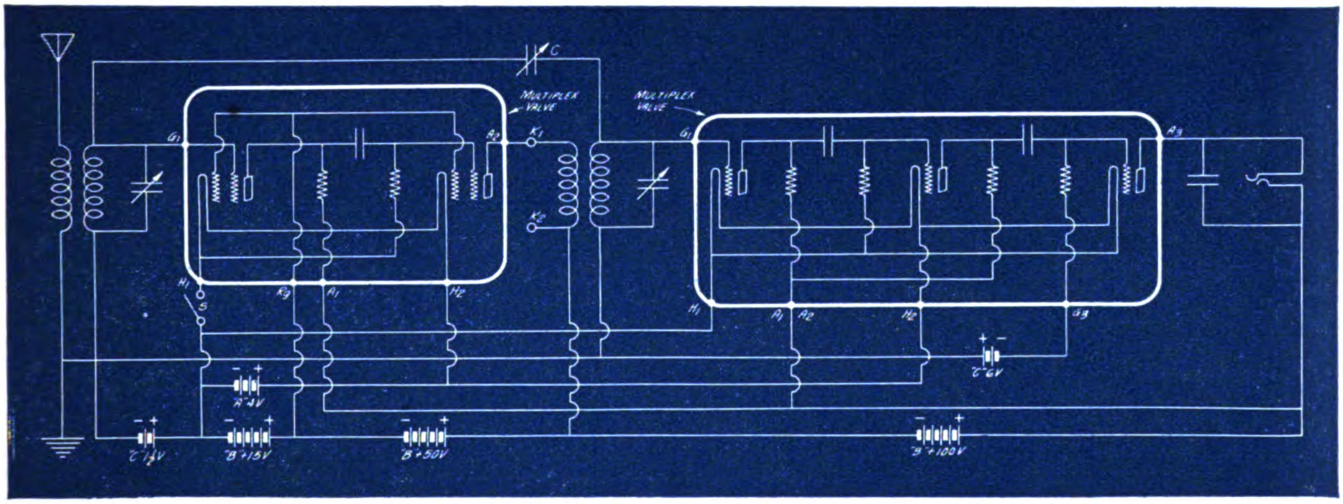
For reception of the local stations, the two high-frequency valves may be switched "off" by the switch S, and the antenna may be connected to K. Especially on the broadcast band of wavelengths excellent results in reception of distant stations may be obtained. The high-frequency amplifier may be any of the usual popular designs, with grounded shields and such devices.

Another excellent circuit is given in Figure 2. This set gives good distance



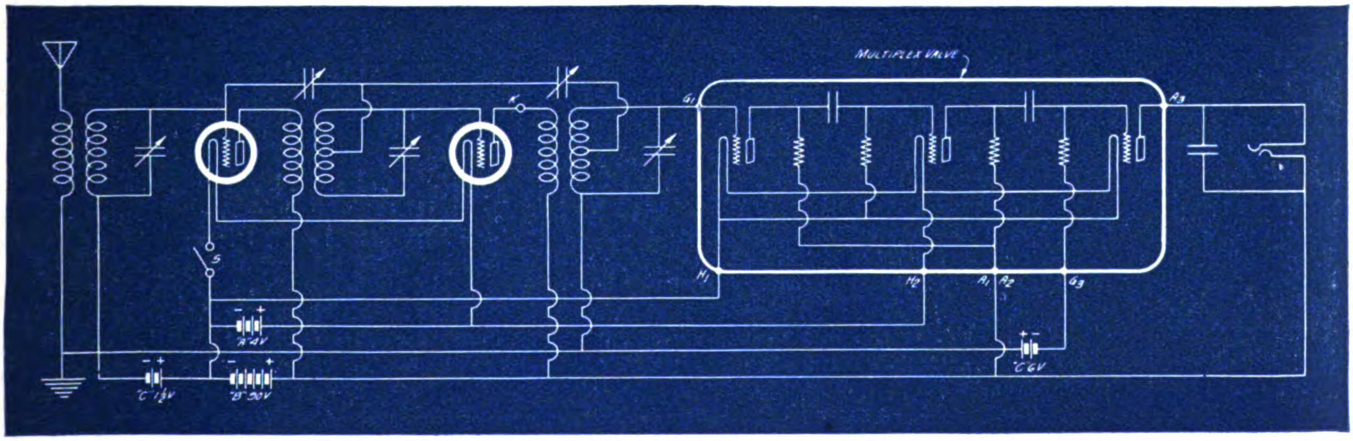
A SUPERHETERODYNE WITH TWO STANDARD VALVES AND TWO MULTIPLEX VALVES

FIGURE 2: *This receiver employs two standard valves as the detector and the oscillator and two multiplex valves as the intermediate and low-frequency amplifiers. The two multiplex valves are the equivalent of three stages of high-frequency amplification, a detector and two stages of low-frequency amplification.*



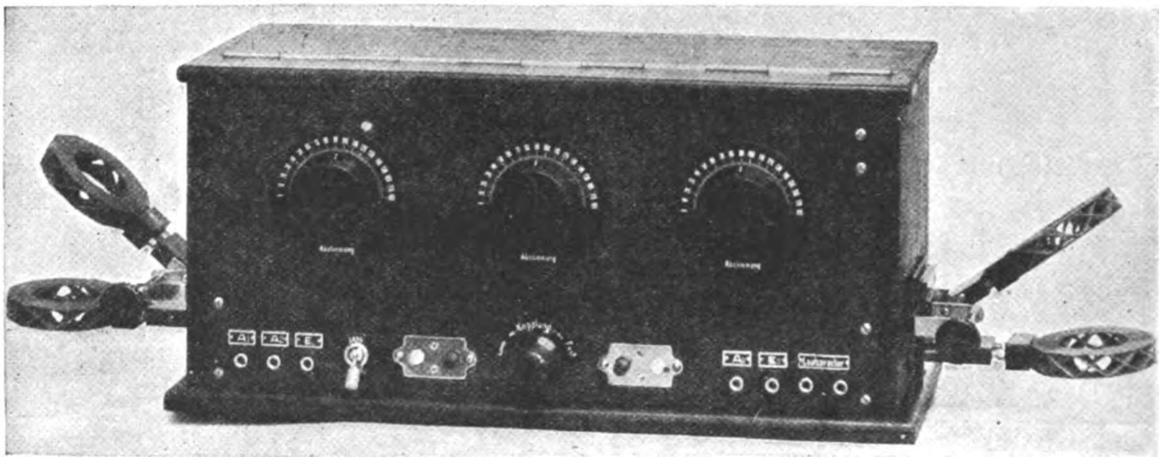
THIS CIRCUIT UTILIZES ONE DUPLEX VALVE AND A TRIPLEX VALVE

FIGURE 3: *In the first valve two stages of high-frequency amplification are obtained, while detection and low-frequency amplification is obtained in the larger or second valve; regeneration is controlled by the small variable condenser, C.*



HOW A MULTIPLEX VALVE IS ADDED TO A TUNED HIGH-FREQUENCY SET

FIGURE 4: ***The first two stages are tuned with three variable condensers and are neutralized by a balancing scheme. The detection and low-frequency amplification is accomplished by means of a single multiplex valve.***



THE OUTWARD APPEARANCE OF A POWERFUL RECEIVER

FIGURE 5: *This is the set (the circuit of which is shown in Figure 4) which employs three valves that do the work of the average five-tube receiver.*

reception on a loop antenna. The intermediate frequency of this superheterodyne is amplified by the first triplex valve, while the second valve amplifies at low frequencies, after rectification has taken place in its first stage. The most important advantage of the receiver, in comparison with similar arrangements of more conventional design, is the extremely small plate-current consumption, due to the fact that the first valve does not receive any direct plate potential at all and four of the following valves have anode resistances of several megohms in series. The total plate-current consumption of this set corresponds to that of an ordinary three-valve set. The filament-current consumption is scarcely more than .7 ampere, in spite of the 8 filaments. Sufficient selectivity is obtained by the use of the variable coupling between the two triplex valves.

In comparison with receivers that employ tuned-intermediate-frequency transformers, this method has the advantage of greater simplicity, apart from the other advantages mentioned above. In the first two stages two similar valves with filament potentials of 2 volts and amplification factors of 10 should be used.

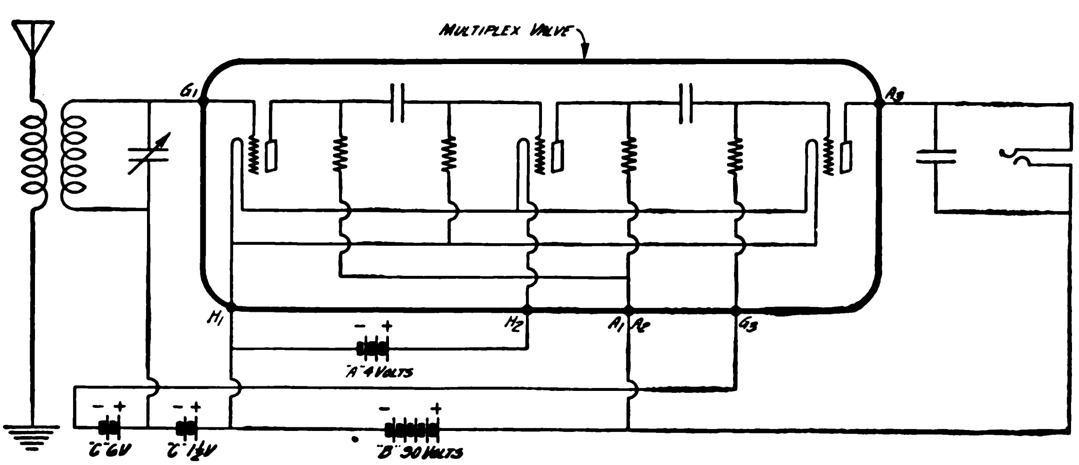
Excellent reception is also attained by the use of a high-frequency duplex valve and a low-frequency triplex valve in cascade. Such a circuit is given in Figure 3.

Regeneration is obtained by means of the small variable coupling condenser, C. But because of the high actual amplification factor of the first aperiodic high-frequency stage, regeneration need not be forced nearly so far toward the point of oscillation as is otherwise usual. Thus the set becomes simpler to operate, and the operator is less liable to cause interference to his neighbors. At the same time, the side-band distortion of the longer wavelengths, due to the use of excessive regeneration, is considerably reduced, so that, under favorable atmospheric conditions, distant stations may be received with practically the same purity as the local broadcasters. Because of the large amplification of this duplex valve, the maximum capacity of condenser, C, ought not to exceed about .000003 mfd.

Since these valves are scarcely larger than ordinary power valves, the receivers described above may be of comparatively small dimensions.

Figure 5 shows the exterior of a receiver that embodies the circuit given in Figure 4.

As yet it is too early to decide the question whether the multiplex systems will lead to special circuits that are not practicable with normally constructed valves and components, or whether the existing circuits will only be modified for use with multiplex valves and remain unchanged in principle.



HOW A SINGLE MULTIPLEX VALVE IS EMPLOYED IN A CIRCUIT

FIGURE 6: *In this circuit, that comprises detection and two stages of low-frequency amplification, a single multiplex valve does all the work. This valve has very low filament consumption and is easily installed.*

A NEW FORM OF

Radio Waves That Kill

From the laboratories of H. Grindell-Matthews and Dr. W. R. Coolidge have already come remarkable demonstrations of "death rays" that directly affect living creatures. But here is a new use of radio waves—waves that emanate from a broadcasting station and that this spring have indirectly destroyed 190 miles of tent caterpillars—and that offer a real menace to this scourge of the countryside.

By W. GORDON SWAN

LAST spring over 72,000,000 potential tent caterpillars were destroyed by a radio. This spring the number was increased to 300,000,000. One hundred and ninety miles of caterpillars!

Not that these insect pests curled up and died from the direct effect of power waves transmitted by radio and aimed specifically at them. The process was not quite as direct as that—but just the same it was tremendously effective within the broadcast range of station WBZ in Springfield, Mass., where the experiments in fighting this insect plague were made.

The commander-in-chief of this anti-caterpillar campaign was Thornton W. Burgess, creator and head of the Radio Nature League. Those of us who have not heard him broadcast from station WBZ on Wednesday evenings may know him through his newspaper syndicate articles and stories about animals and bugs and reptiles.

To Mr. Burgess came the idea of putting his army of members in the Radio Nature League to work exterminating the tent caterpillars. His army consisted of 143,000 enrolled members.

Standing before the microphone in the Hotel Kimball Studio of WBZ on February 9th, Commander-in-Chief Burgess talked to his army of the coming campaign, which would begin one week from that night and which would last three weeks.

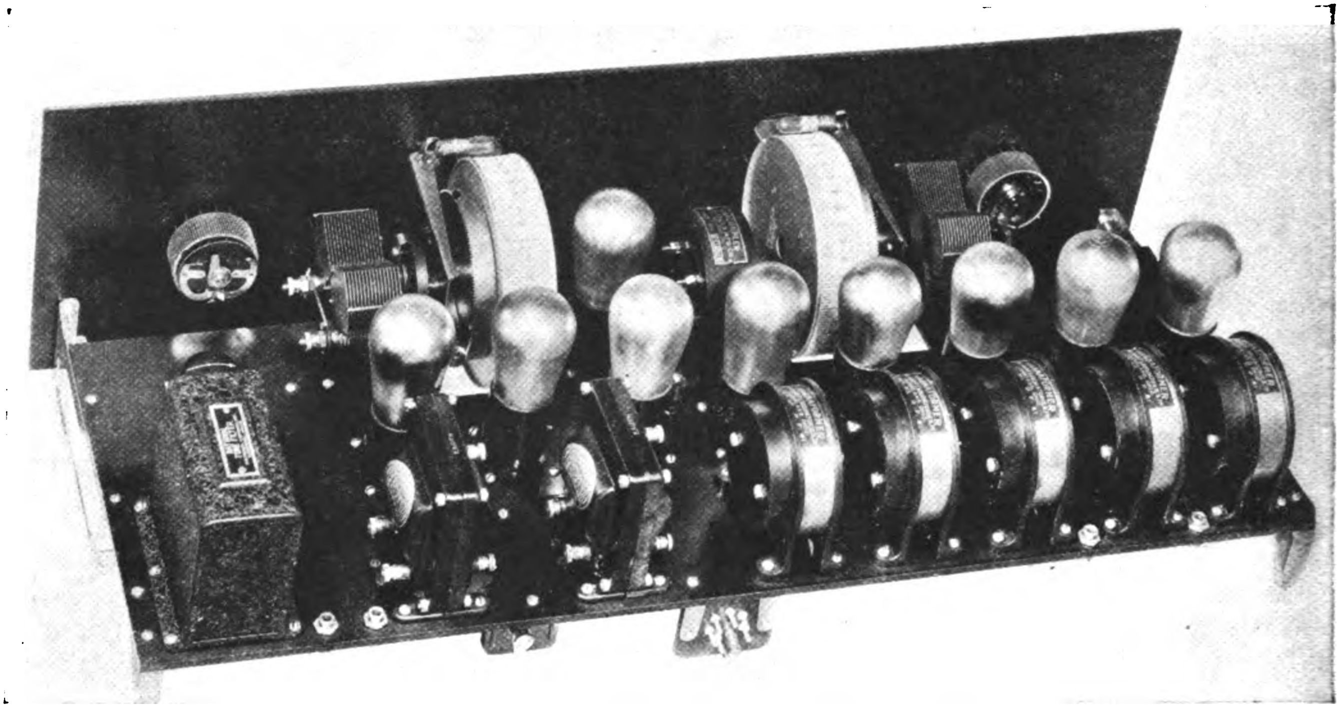
Seated about receiving sets in homes far and wide, children and grown-ups listened to the message. To the rich and the poor these words came from loud-speaker and headphone, from super-het and crystal set, like Paul Revere's call to arms:

"Everyone is familiar with the unsightly webs which appear along the roadsides in the spring and early summer. All know how unsightly the roadsides become with these webs, followed by the stripping of the foliage from the trees. A little careful work now will put an end to these pests. All winter long, on the twigs of the wild cherry and apple trees, the eggs of the tent caterpillar have been waiting for the approach of spring. Just as soon as the first leaf-buds show green, these tiny eggs will release hundreds of caterpillars. If these egg masses are collected now and burned, there will be no caterpillars. It is with the hope of destroying as many as possible of these egg clusters that we are conducting this campaign.

"These little eggs are very easily found. If you examine the twigs of wild cherry trees and of apple trees you will find little shiny masses completely surrounding a

(*Continued on page 159*)

¶ The latest developments in superheterodyne theory and construction are embodied in the Magnaformer-9-8 Receiver, about which this article gives advance information.



A REAR VIEW OF THE POWERFUL NEW SUPERHETERODYNE

FIGURE 1: *This picture gives a good idea of the neat and efficient layout of the nine-valve receiver that has been especially designed for tone quality and powerful reception, both distance and local, on a loop antenna.*

ADVANCE INFORMATION ON

The Magnaformer 9-8 Receiver

Superheterodyne fans will be more than interested in this advance article on the theory of a new receiver that should meet all their requirements for loop reception. The article gives an outline of the theory of the new set, with the reasons for its improved sensitivity and reliable operation. The feature of changing the receiver from a nine to an eight valve set by means of a simple switch lends itself admirably to all-around use where both distance and local reception are required.

By L. M. COCKADAY

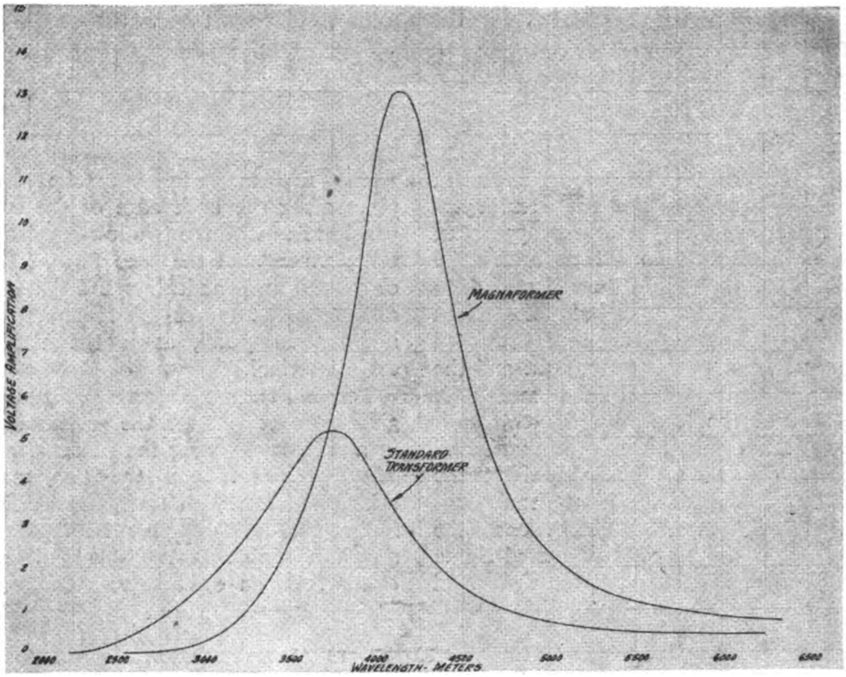
WHILE experimenting in the POPULAR RADIO LABORATORY with this new set for the home builder, three notably interesting qualities were discovered; they may be tabulated as follows:

1. The capacity to get great distance on a loop antenna;
2. The simplicity and stability of operation;
3. Excellent tone quality.

Throughout the experiments conducted by the engineering staff of POPULAR RADIO on this new receiver, the operation of the Magnaformer 9-8 receiver was found to be an improvement over any of the superheterodyne receivers that as yet it had tested; the selectivity obtained in the crowded sections in New York City was all that could be desired.

A few minutes investigation into the methods employed to obtain these results will be interesting and enlightening to the experimental radio fan.

In the first place, the new circuit consists of an initial detector coupled to a simple oscillator that produces the necessary beat frequency and supplies it to the input transformers of the four stage, fixed-tuned, high-frequency amplifier. These transformers are peaked at about 72 kilocycles, or at about 4140



THE RESONANCE CURVE OF A MAGNAFORMER COIL

FIGURE 2: *Notice the improved amplification obtained, as well as the sharper tuning, with the Magnaformer, which, in this case, has been tested against another standard transformer used for the same purpose.*

meters in wavelength. There is a switch on the front of the panel for cutting out one stage of high-frequency amplification, when this extra sensitivity is not necessary or advisable.

The output energy from the amplifier is then supplied to a second detector equipped with a high-frequency filter connected in the plate circuit. The rectified energy from this circuit is then applied to a high quality, low-frequency amplifier of two stages, and from there it is supplied to an output filter, in whose circuit may be connected a standard reproducer.

The first seven valves utilized in this receiver are of the standard UX-201-a type, while the eighth and ninth valves are of the UX-112 and UX-171 type respectively.

The schematic circuit for this new receiver is shown in Figure 4. At the left are shown the terminals for the loop antenna that is tuned by a variable condenser. It is connected to the first detector.

Notice that this valve's filament and the filament of the oscillator valve are controlled by means of a 10-ohm rheostat. This makes it possible to obtain the correct oscillator current and detector action for the highest efficiency. This rheostat is placed inside the set and need be adjusted but once.

The second variable condenser connected across the grid and plate of the oscillator valve (shown at the bottom of the diagram in connection with the three coils of the unicoupler) is the only remaining tuning control. It varies the frequency of the oscillator, so that a beat of 72 kilocycles may always be obtained between the loop tuner and the oscillator. This beat frequency is then applied to the high-frequency amplifier as described previously.

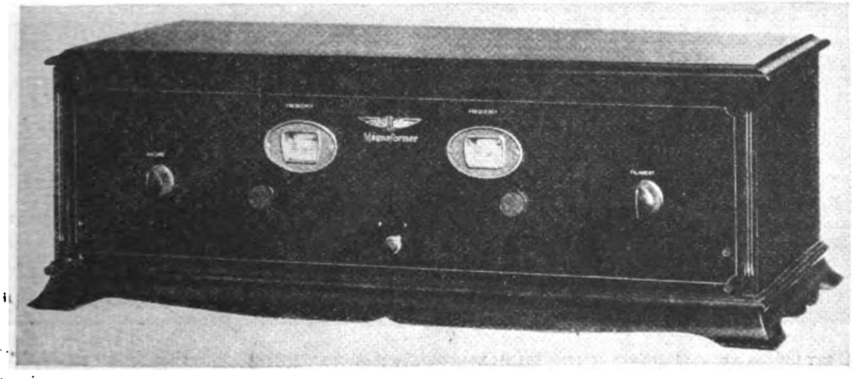
The second filament control, located inside the set, has a 30-ohm rheostat for controlling the current flowing into the filament of the second detector valve. This need be adjusted but once. The last two valves are controlled by automatic filament controls, and each passes one-half ampere to each of the last two valves.

On the front panel are the remaining two operating and volume control resistances. One of them is a 10-ohm rheostat that controls the filament current of the four high-frequency valves. This may be used as a volume control. There is also a 400-ohm potentiometer that controls the grid bias of the same four valves, to keep them stable and to give just the right amount of sensitivity and sharpness to the circuit that may be required.

The five air-core intermediate transformers each consist of a primary winding and a secondary winding (random wound on a bakelite spool). Across the secondary winding is connected a semi-variable condenser for the purpose of tuning the secondary coil to a predetermined and definite frequency. This condenser is constructed of brass plates, and is so designed that its capacity may be varied by simply turning a nut. Both the coil and the condenser are resonated and sealed inside their bakelite case and cannot be changed afterward. The condenser is outside the field of the coil.

The mechanical characteristics of the Magnaformer have been given a great deal of thought and attention to make them physically rigid, and to forestall any chance of the tuning being varied after it has once been set. Two bolts are used through the coil and the ends are then locked into a metal band that extends around the unit, so that there is no possibility of their moving. The windings themselves are impregnated in wax, as well as the semi-variable condenser, after it has been adjusted. The metal band and a small plate that is placed along the side of this coil serve as a load that tends to suppress unwanted oscillation. The metal band also acts as a shield that allows the transformers to be placed side by side without serious interaction.

The efficiency of these new transformers is indicated by a comparison of the amplification curves, shown in Figure 2, of another standard make of intermediate transformer and the new Magnaformer coils.



THE MAGNAFORMER RECEIVER COMPLETE

FIGURE 3: *This illustration shows the new set installed in its cabinet and ready for operation. A complete description of how to build this set appears in the October issue of* POPULAR RADIO.

This is one of the reasons for the great sensitivity that may be obtained without sacrificing tone quality.

The General Constructional Features of the New Receiver

A study of the illustration shown in Figure 1 reveals the neat and symmetrical arrangement of the apparatus. Most of it is mounted on a bakelite sub-panel that is in turn fastened to metal brackets that hold the front panel. The potentiometer is mounted on the front panel at the right and the combination rheostat and switch is placed at the left, with the two variable condensers affixed to illuminated drum dials and spaced in about the centre portion of the front panel.

All of the valves except one (the oscillator valve), are mounted in a straight line beginning at the right-hand edge of the sub-panel, looking at the set from the rear. The oscillator valve is mounted toward the front panel alongside of the unicoupler. These two pieces of equipment are spaced between the two front dials.

The five magnaformers take their place along the back edge of the sub-panel in line with the two low-frequency transformers and the tone filter. The choke coil and condensers and the miscellaneous resistances are mounted below the sub-panel, as is the Yaxley cable terminal.

The illustration shown in Figure 3 gives a front view of the set installed in a cabinet, showing the filament and volume controls and the two main tuning controls with their clear vision indicators. At the lower centre is shown a switch that changes the receiver from an eight valve receiver to a nine valve receiver for distance work.

In operation the set is normally left on eight valves except for extreme distance work. The set is usually used with a straight loop antenna and gives the best results with the Qualitone Loop, which has the correct inductance.

The set is really easy to build although it utilizes nine valves. For anyone who wishes to use an ultra-sensitive set without an outdoor antenna, the new Magnaformer 9-8 Receiver should be ideal.

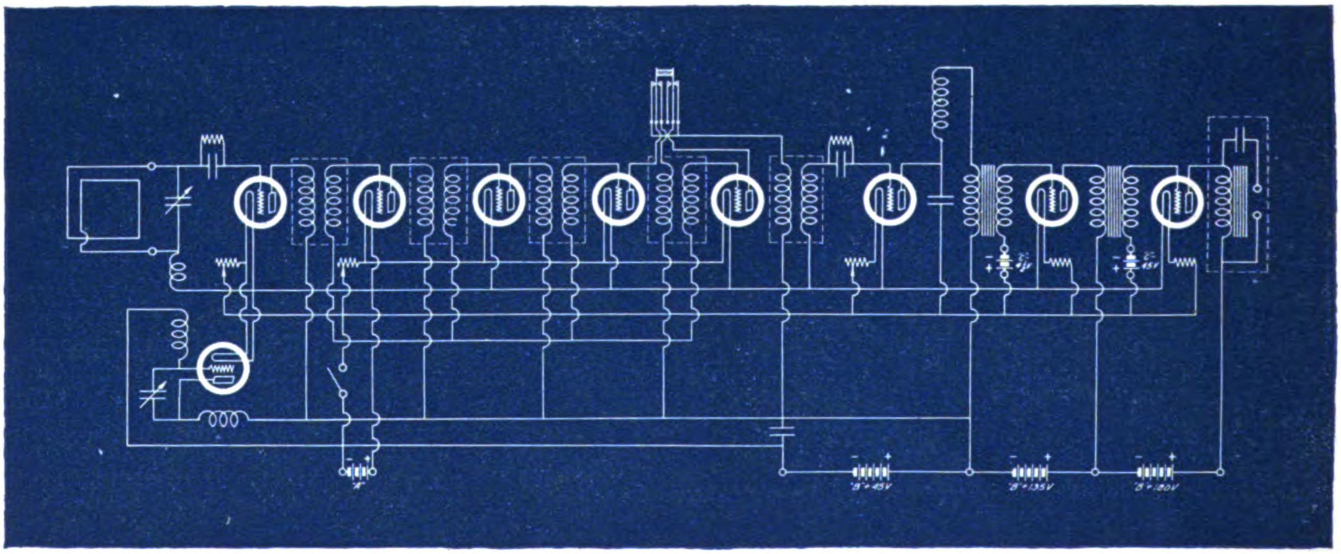
In the next issue of POPULAR RADIO will be found complete constructional details for building this set. For the benefit of the set builders who wish to purchase the instruments and accessories now, so that they will have them on hand when the constructional article appears, the list of parts necessary to build the Magnaformer is given here:

LIST OF INSTRUMENTS AND ACCESSORIES NECESSARY FOR BUILDING

The Magnaformer 9-8 Receiver

TO BE FEATURED IN THE OCTOBER, 1927, NUMBER OF POPULAR RADIO—

1 Formica front panel, 7 by 26 by 3/16 inch;
1 Formica sub-panel, 9 by 25 by 3/16 inch;
5 Magnaformer intermediate transformers, unit R. F. No. 61;
1 Unicoupler, unit C. U. No. 71;
2 Remler Universal drum type dials with controls, No. 110;
2 Remler .0005 mfd. variable condensers, No. 639;
9 Benjamin sockets, No. 9044;
2 Benjamin sub-panel brackets, 2 inches high, No. 8629;
2 Ferranti low-frequency transformers, A. F. No. 4 or A. F. No. 3—A. F. No. 4;
1 National tone filter;
1 Samson high-frequency choke coil, No. 125;
2 Aerovox .00025 mfd. grid condensers, type 1475, with mountings;
1 Aerovox .001 fixed condenser, type 1450;
1 Aerovox 1 mfd. by-pass condenser, type 200 short;
2 Durham 2-megohm grid-leaks;
1 Frost DeLuxe 400-ohm potentiometer, gold arrow knob, No. 1824;
1 Frost DeLuxe 10-ohm combination rheostat and battery switch, gold arrow knob, No. S1810;
1 Frost DeLuxe 10-ohm rheostat, No. 1810;
1 Frost DeLuxe 30-ohm rheostat, No. 1830;
4 Frost tip jacks, No. 253;
2 No. 112 amperites, with holders;
1 Yaxley cable connector plug, No. 660;
1 Yaxley radio jack switch, No. 60;
12 Feet Acme bus bar wire, No. 14, round tinned;
25 Feet Acme flexible spaghetti covered wire;
1 Quali-Tone loop—Duro Metal Products Co.;
1 5/8 by 5/8 by 2-inch wood block for sub-panel center support;
2 2-inch right-angle supports for supporting rear of sub-panel;
Wire, screws, lugs, nuts, bolts, solder.



THE SCHEMATIC DIAGRAM OF THE CIRCUIT EMPLOYED IN THE MAGNAFORMER RECEIVER

FIGURE 4: *At the left is the connection to the loop antenna, with the oscillator valve just below it. In the center of the diagram, at the top, is the change-over switch that cuts out one intermediate-frequency amplifier and thus converts the receiver from a nine-valve to an eight-valve set for local reception.*

"Embalming" Radio Programs in Wax

A new method for recording radio broadcast programs on talking-machine cylinders—a process that makes possible the collection of a radio broadcast "library"

By S. T. WILLIAMS

P. & A. Photos

HOW RADIO HOWLS ARE RECORDED

This particular apparatus was used by Eric H. Palmer (shown in the center of the picture) to record the heterodyning between stations from 200 to 2,500 miles apart; the records were made on wax cylinders and were sent to Washington, D. C., as evidence upon which the Radio Commission may base new allocations for radio broadcasting stations.

WHEN President Coolidge speaks over the radio nowadays his voice is heard by millions in all sections of the country. And in 50 years from now this speech may still be heard, for a permanent phonographic record can now be made which may be reproduced with the clarity and volume of the original. The Victor Talking Machine Co. is doing this work at present, as a human institution and not as a commercial organization. The Victor radio programs broadcast during the past seasons have been recorded in their entirety. The purpose of these recordings was to provide both a permanent record and a means whereby the concerts might be adjudged.

The experimenter will be interested in the new system of electrical recording that affords a particularly simple manner of making records of broadcast programs without any sound reproduction taking place in the actual recording apparatus. A diagram of the recording system is shown in Figure 1.

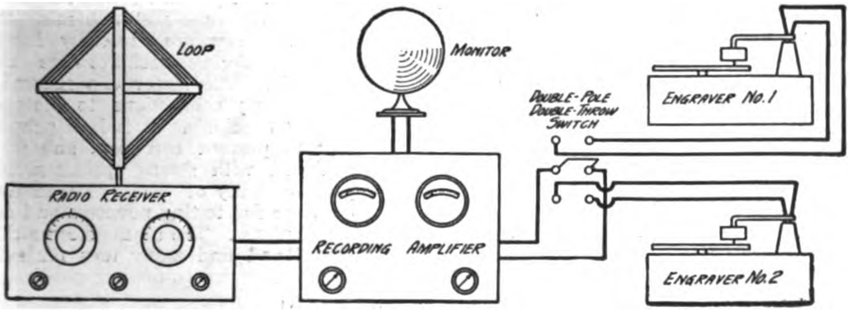
A high-grade radio receiver is employed. The low-frequency output of this receiver is fed into the regular electrical recording amplifier, where it is further strengthened. The output of this amplifier is then connected to the electrical engraver which inscribes the electrical vibrations on a rotating wax disc, just as the regular artist recordings are made in the Victor laboratories. A metal matrix of the wax is then taken by means of an electroplating process, and from such metal discs the familiar black records are pressed.

The recording is done at the standard speed for phonograph recording, 78 revolutions per minute. The records can thus be reproduced with perfect fidelity on the ordinary phonograph.

Two turntables and two master wax records can be used as shown in Figure 1. This method eliminates any interruption to the continuity of a speech or musical program, for the two turntables with the two wax "masters" can be revolved simultaneously. Shortly before the one wax surface is completed, the second electrical engraver can be lowered to the surface of the other wax tablet, and the amplifier output thrown over at the proper time by means of a double-pole, double-throw switch.

A radio reproducer monitor is connected to the amplifier, allowing the operator to judge the volume and character of the program reception being delivered to the electrical engraver.

Here is a chance for the real fans to establish radio broadcasting "libraries" of wax cylinders. Collections of the recorded radio talks of great personages might some day have the value that we now place on collections of old books or letters or autographs.



THE HOOK-UP FOR RECORDING RADIO PROGRAMS

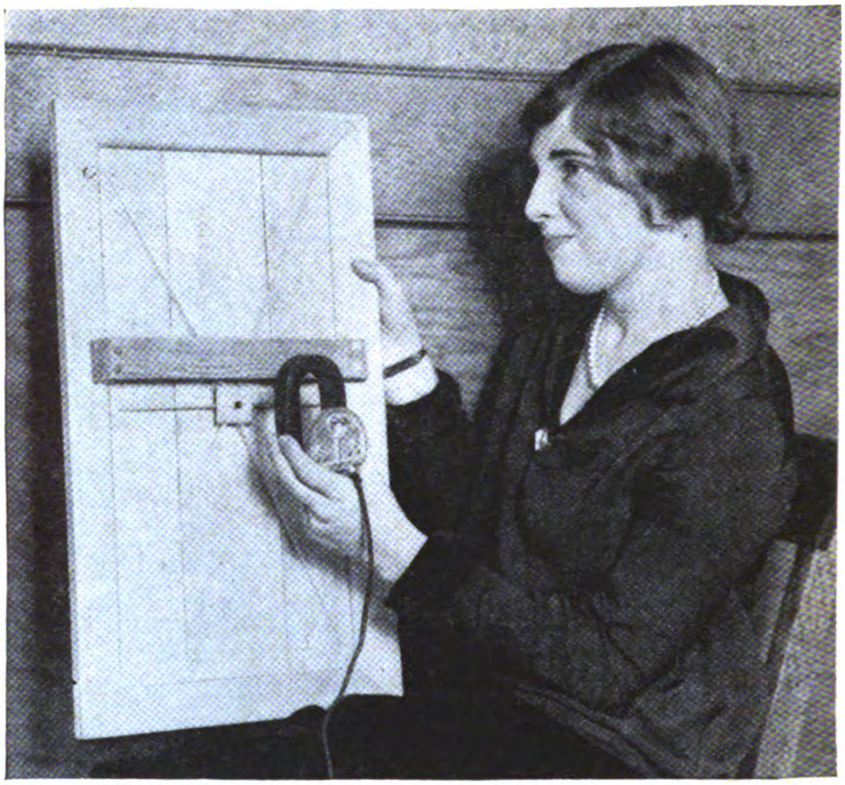
FIGURE 1: *This diagram shows how the continuity of a long recording is obtained by the use of two electrical engraving systems with a change-over switch. These are shown at the right of the diagram. At the left are the standard receiver and the recording amplifier.*

What's New *in* RADIO

Conducted by

THE TECHNICAL STAFF

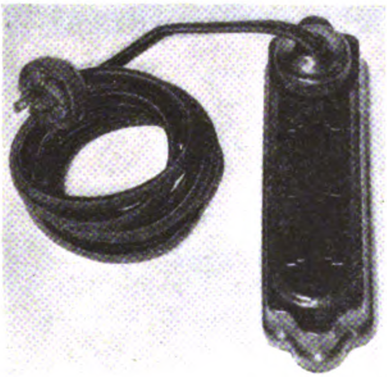
Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY, it will be duly recorded in this Department for the information and benefit of all.



Underwood & Underwood

A REPRODUCER SOUNDING BOARD SEVEN TIMES LIGHTER THAN CORK

This reproducer sounding board is made from Madera de Balsa wood, a material found in the jungles of Central America, and here cut to a thickness of three thirty-seconds of an inch. This device was designed to be hung on a wall and used as a mounting for a picture or tapestry.



A Handy Three-Way Socket

Name of instrument: Three-way convenience outlet for the house-lighting lines.

Description: This three-way outlet, sometimes known as the "table-tap," consists of a composition shell with accommodations for three standard electric cable plugs. Mounting holes are provided for screws to be used in mounting the device on the wall or baseboard; or it may be simply laid on the floor or table if desired. A fourth receptacle is provided for the cable, which is furnished with the unit, and is intended for use in connecting it to a light socket.

Usage: Where only a single outlet or socket is available for connecting the battery charger, "B" power-pack, etc., to the light lines, this unit may be used. It plugs into the single outlet, making three outlets available.

Outstanding features: Good appearance. "T" type slots to accommodate either type of standard plugs. All "live" parts completely inclosed within composition shell.

Maker: Harvey Hubbell, Inc.

No Chance for Shocks With This Terminal

Name of instrument: Binding post terminal.

Description: This binding post consists of a solid metal rod that is imbedded for part of its length in a composition covering. The exposed part of the rod is threaded for attaching the post to a panel. When the spring collar is drawn up toward the cap, the brass rod is exposed and the connecting wire may be slipped into a hole provided in the rod. The collar may then be released and will spring back, to make a firm contact on the wire.

Usage: As a connection terminal to be mounted on any instrument to facilitate making connections between it and other instruments.

Outstanding features: Fully insulated. No twisting necessary in making a connection.

Maker: Frank W. Morse Co.

Handy Hardware for Every Radio Fan

Name of instrument: Miscellaneous radio small parts.

Description: This group consists of brass wire connectors, clips and brackets. The wire connectors are brass tubes with set screws, so arranged that two wires can be joined by inserting their ends in the tube and tightening the screws. They are especially handy where soldering facilities are not available. The larger clip shown is for making connections to storage-battery terminals. It is lead galvanized to prevent corrosion, and it is equipped with strong springs which provide plenty of "bite." The smaller clips are for testing purposes and are nickel plated. The brackets are nickel plated and find many uses for supporting sub-panels, binding-post strips, and other duties.

Usage: For miscellaneous purposes in set construction.

Outstanding features: Well designed to meet the requirements of the set builder.

Maker: Frank W. Morse Co.

A Handy Cord Connector

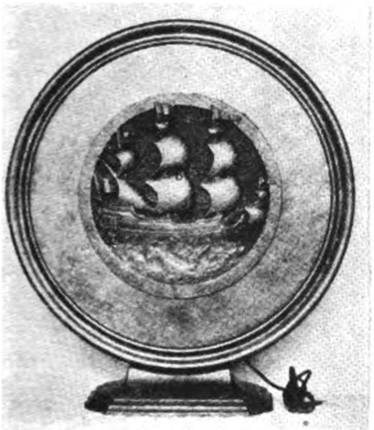
Name of instrument: Extension cord connector.

Description: The connector consists of two spring metal connectors inclosed in a composition block. There are two holes provided in each end of the block. The connector springs are so arranged that when a phone tip is inserted in one of them it is strongly gripped by the spring and a direct connection is made to another tip inserted in the corresponding hole at the other end of the block.

Usage: For connecting an extension cord to the end of the reproducer cord when it is desired to move the reproducer some distance away from the receiver. The two phone tips on one end of the extension cord may be inserted in the two holes in one end of the connector, and the reproducer cord terminals may be inserted in the holes at the other end, thus making a positive connection between the two cords.

Outstanding features: Firm grip. Small size. Insures positive electrical connection.

Maker: Frank W. Morse Co.



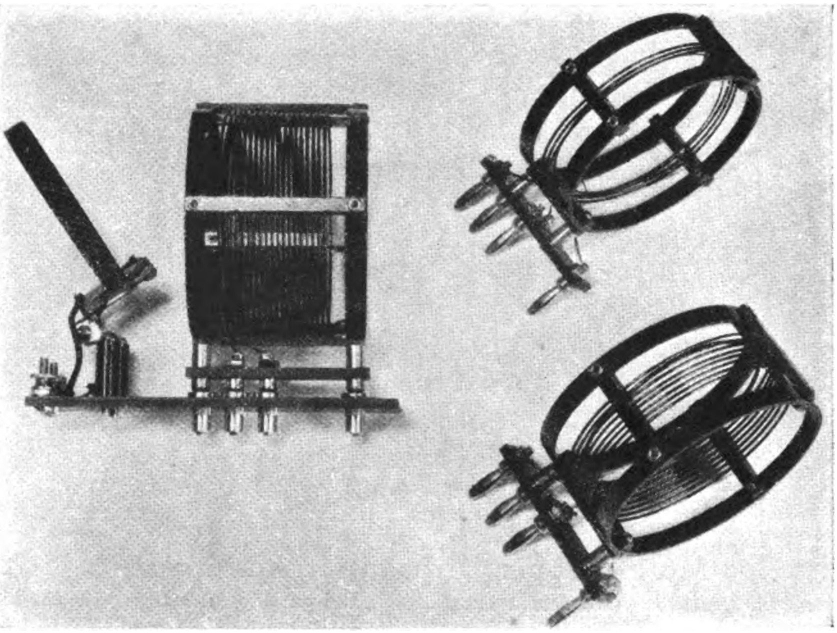
An Artistic New Cone

Name of instrument: Cone reproducer.

Description: The cone employed in this unit is of specially prepared fabric. The edge is bound with felt and rests on a wooden resonance sounding board, which serves as the front of the reproducer. The center of this wooden front is cut out and the opening is covered with a wrought iron medallion carrying the design of a sailing vessel, which serves as a grill. The whole reproducer is finished in mottled gold. An adjustment is provided, in the form of a small set screw, to permit regulation of sensitivity and quality of reproduction.

Outstanding features: Decorative appearance. Rugged. Low cost and good volume.

Maker: Algonquin Electric Company, Inc.



Reliable Coils for the Short-Wave Fan

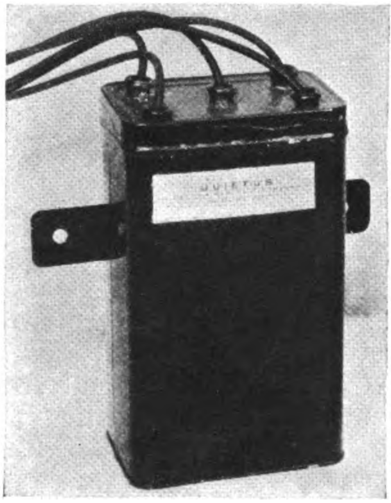
Name of instrument: Short-wave plug-in coils and mounting.

Description: This coil kit contains a mounting-strip which carries four small jacks and a movable primary winding. This strip is intended to be mounted on the baseboard or subpanel of a receiver, and for that purpose is equipped with insulated bushings that keep the strip well up off the baseboard. There are also three coils in this kit that cover three wavelength bands. The mounting strip, with one of the coils plugged into place, is shown at the left of the illustration above. In the short-wave range it is necessary to employ several coils of different sizes, if it is desired to cover any appreciable part of the wavelength band below 200 meters. The three large coils shown in the illustration cover a range of from 15 meters to 130 meters. The smallest coil covers the band around 20 meters; the medium coil covers the 40-meter range and the largest one covers the range from 80 meters to 130 meters. These coils are constructed on a skeleton insulated frame. The windings are clamped at four points by cross strips, and these in turn are supported by the insulating hoops. This method of construction provides good protection for the windings and makes for ruggedness and high efficiency. Similar plug-in coils are obtainable for use with the higher waveband up to 550 meters.

Usage: As the coils and mounting for use in the construction of a short-wave receiver.

Outstanding features: Highly efficient. Coils instantly interchangeable. Rugged and durable construction. Each coil unit consists of secondary and tickler windings.

Maker: Aero Products, Inc.



A Device That Stops Interference at Its Source

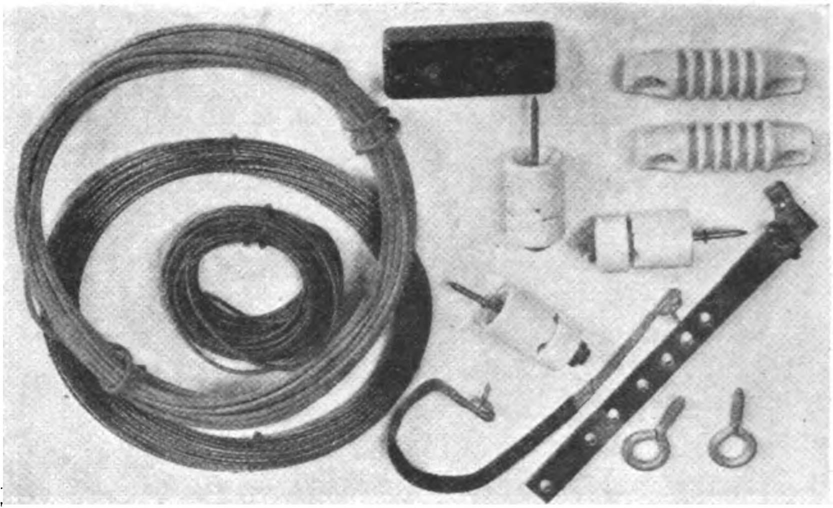
Name of Instrument: "Quietus" interference filter.

Description: This filter unit is sealed into a black metal can that measures approximately 4½ by 2½ inches by 6½ inches in height. At the top of this case are located five insulating bushings through which five wires are brought out. Two of these leads connect to the supply line; two connect to the input terminals of the machine that is causing the interference; the fifth is connected to the ground. The function of this unit is to provide a barrier to prevent the interference from getting out into the supply line, and to by-pass the interference to ground.

Usage: For connection between supply lines and electrical apparatus to prevent interference that originates in the apparatus from getting back into the supply lines where it would cause disturbing noises in nearby radio receivers.

Outstanding features: Reduces extraneous noises. Completely sealed in. For use where the supply is either direct or alternating current, at a voltage not exceeding 220 volts. Current carrying capacity is 8 amperes. Easy to install.

Maker: Day-Fan Electric Co.



No More Shopping Around for Antenna Parts

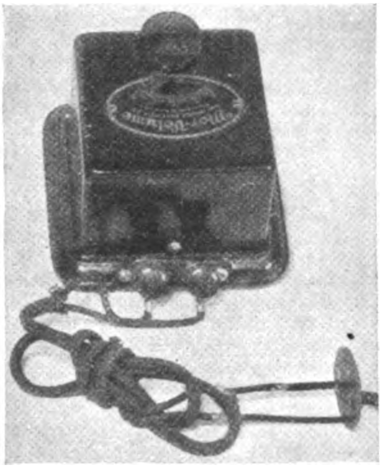
Name of instrument: Complete antenna kit.

Description: All of the parts required for the erection of an outdoor antenna are included in this kit. Complete instructions for the erection of an antenna are included in each kit, along with an explanation of the function and purpose of each item in the kit. Materials included in the kit are all of high quality.

Usage: In the construction of an outdoor antenna.

Outstanding features: Good quality materials. Complete in every detail.

Maker: Cornish Wire Co.



Sensitivity and Greater Volume from Your Present Receiver

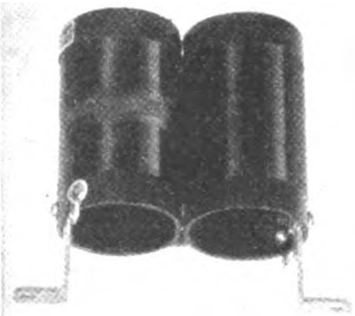
Name of instrument: "Mor-Volume."

Description: A coil and slider are inclosed in a small metal case to provide a variable inductance. The knob which controls the slider is mounted on a shaft that protrudes through the top of the case. The knob is equipped with a pointer which moves over a calibrated scale. Two binding-post terminals are mounted on the base of the instrument, and a two-conductor cable is supplied for making the connections between this instrument and the receiver with which it is to be used. The receiver end of this cable terminates in a composition disc with four holes to fit the prongs of a standard UX-type vacuum valve base. To connect the device to the receiver it is only necessary to remove the detector valve from its socket and slip the composition disc over the prongs in the base of this valve. The valve is then returned to its original socket, and all is in readiness for operation.

Usage: To be connected in the plate circuit of the detector of any standard receiver, to provide a tuned plate circuit.

Outstanding features: May be connected to any receiver without any alterations in the wiring or connections of the receiver. Provides greater sensitivity and volume than is obtainable with the receiver alone. Sold under a guarantee with a three-day trial offer and a cash refund of the purchase price if it does not justify the maker's claims.

Maker: Bruce Electric Co.



A Coil of Efficient and Accurate Characteristics

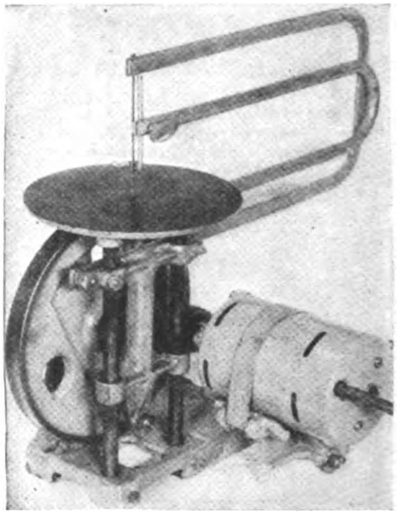
Name of instrument: Air core, high-frequency transformer.

Description: Enameled wire is space wound on a threaded composition tubing in the construction of this coil. The secondary winding is divided into two parts and one of these sections is split to provide room for the primary winding. The secondary sections do not contain the same number of turns, but are proportioned so that their inductance is equal. This disparity in the number of turns is accounted for by the fact that the section which is closely coupled to the primary has a higher inductance per turn, due to mutual inductance, and therefore requires fewer turns to equal the inductance of the other secondary section. The two coils are assembled in "binocular" fashion. Terminals are in the form of soldering lugs at the bottom of the coil form, and the mounting feet are higher than usual to allow ample clearance between the coil and the base in cases where a metal sub-panel or shield is to be used under the coils. The coil is designed for use in connection with a .000275 mfd. condenser for the present broadcasting band.

Usage: As an intervalve coupling device in a tuned high-frequency amplifier.

Outstanding features: Equal distribution of inductance practically eliminates external pick-up and therefore gives better selectivity and greater stability in an amplifier in which the coils are used. Neat construction. Careful design.

Maker: Acme Products Co.



Fancy Cabinets Can Be Made at Home With This Electric Saw

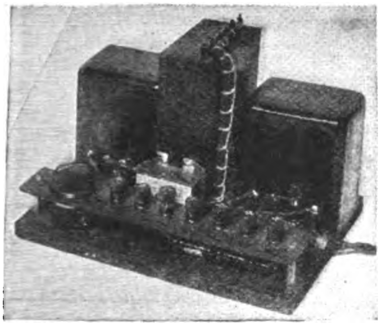
Name of instrument: Electric Jig Saw.

Description: This saw is designed to make use of a detachable motor. The saw consists of a heavy iron base and a flywheel together with a bladeholder guard and mechanical operating equipment. The motor is attached by means of a steel strap in a fixed position provided on the base of the saw. For this use a friction pulley is attached to the end of the motor driveshaft and the driving force is applied to the periphery of the large flywheel through its frictional contact with the motor pulley.

Usage: For cutting wood, rubber or bakelite into irregular shapes.

Outstanding features: Small in size. Uses detachable motor. Works rapidly. Easily and quickly assembled. Motor can be attached or detached in a few seconds. Strongly constructed. Simple to operate.

Maker: Electro Magnetic Tool Co.



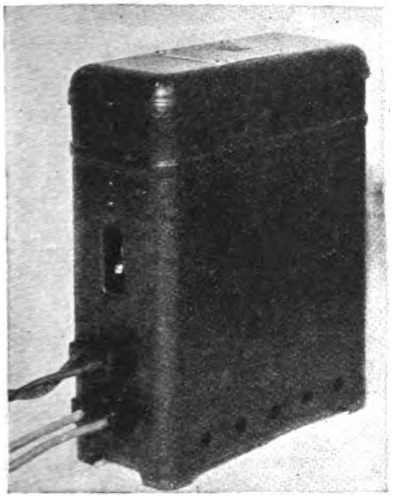
This Kit Simplifies Home Construction of a "B" Power-Pack

Name of instrument: "B" power-pack kit.
Description: This power-pack is sold in kit form for the convenience of the fan who prefers to "build his own." The kit consists of all the necessary parts. When completed, this unit will deliver "B" voltages required for the operation of any receiver, including the high "B" voltage required for the operation of a UX-171 type power valve in the last stage. It also supplies the "C" and "A" voltages for this power valve. The power-pack is designed for use with a UX-213 type of rectifier valve, and also makes use of a voltage regulator valve to maintain constant voltage at the 90-volt tap.
Usage: To supply all "B" voltages to any receiver; also the "A" and "C" voltages for a power valve used in the last stage of the receiver.
Outstanding features: Unusual voltage stability. Variable "C" biasing voltage. Supplies filament current for power valve. Easy to assemble. Compact.
Maker: Silver-Marshall, Inc.

P. & A. Photos

A FRENCH COMBINATION OF PHONOGRAPH AND MOVIE

This apparatus was designed to combine the phonographic and the "cinema art" by recording sound in very fine grooves or scratches along the edge of a motion picture film. Its inventors, Mr. and Mrs. Francis M. Johnson (he is American, she is French) are shown with the apparatus.

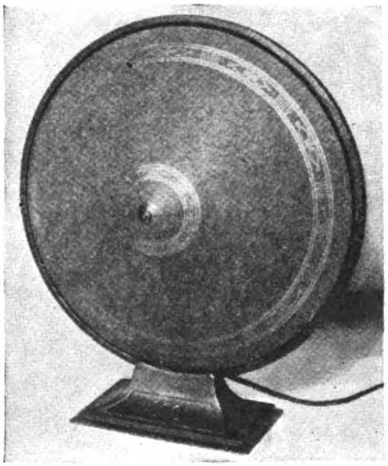


This Unit Will Keep the Storage Battery at the Proper Charge

Name of instrument: Trickle charger.
Description: There are no acids, liquids or vacuum-valve rectifiers in this charger. Rectification is obtained through the use of dry plates which require no attention whatsoever. The unit consists of the usual step-down transformer and a new-type rectifier, inclosed in a perforated metal case. It is equipped with a switch on the outside of the case, by means of which the charging current may be turned "on" and "off" at will. It also has a cable and plug for connecting to the AC light lines, and a pair of rubber-covered wires by means of which the charger may be connected to the battery. The charging rate is self-regulating, in that the charger will operate at full capacity until the battery is fully charged; then the current will taper off to a lower value that cannot overcharge the battery.
Usage: For trickle charging 4 and 6-volt storage batteries from the 110-volt, 60-cycle lighting lines.
Outstanding features: Requires absolutely no attention other than turning it "off" and "on." Even this attention can be eliminated by the use of an automatic relay switch. Provides tapering charge that prevents overcharging of battery. The rectifier plates have a long life and when finally worn out may be replaced at nominal cost.
Maker: Elkon Works, Inc.

Exact Regulation of Voltage Is Obtained with This Power-Pack

Name of instrument: "B" power-pack.
Description: An electrolytic rectifier is employed in this unit, in conjunction with a filter and the necessary output resistances. All are inclosed in a neat metal case that is finished in gold. Terminals are provided on the front for four different "B" voltages, three of which may be varied by means of the three knobs that are mounted just above the terminal strip. A switch is also provided, by means of which the AC supply to the power-pack is turned "off" and "on." The unit operates from the 110-volt, 60-cycle light lines and supplies adequate output voltage for the operation of practically any receiver, including those that make use of either a 112 or 171-type power valve in the last low-frequency stage.
Usage: In place of "B" batteries for the operation of radio receivers.
Outstanding features: Low cost. Neat appearance. Supplies adequate voltages. Various output voltages variable to meet requirements of any receiver.
Maker: Warren Electric Co.



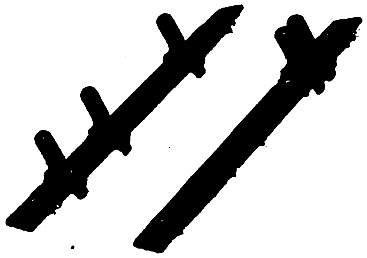
A Sturdy Cone Reproducer

Name of instrument: The O'Neill cone reproducer.
Description: This reproducer is of the semi-floating cone type. The cone is of parchment paper with the usual set screw and bushing arrangement for regulating the tension on the cone. The frame and base are of metal and are finished in a brown tone to match the color of the cone. The cone is decorated in gold to relieve the monotony of the otherwise large, unbroken cone surface.
Outstanding features: Neat in appearance, will not tip over, and distinguished by good overall performance.
Maker: O'Neill Mfg. Co.

P. & A. Photos

MILE-HIGH BROADCASTING

Aboard this radio-equipped airplane, John C. Thomas, baritone (shown at the microphone), recently broadcast his voice while speeding through the air a mile above New York City. A new invention gives to the radio set the clarity and amplitude necessary to broadcast above the roar of the airplane motor.



These Units Will Regulate Power-Pack Voltage

Name of instrument: Voltage control units for "B" power-packs.

Description: These units consist of specially prepared composition strips, upon which is wound high resistance wire of adequate current-carrying capacity. A set of these resistances for the average "B" power-pack consists of two units, which may be connected together in such a way as to provide two variable grid-biasing voltages, three variable intermediate voltages and a fixed high voltage for the operation of a power valve. The variable voltages are obtained through the use of sliders which make contact with a bare portion of the resistance windings. The over-all resistance of the double unit is approximately 10,300 ohms.

Usage: As the voltage control resistor for use in the output circuit of a "B" power-pack.

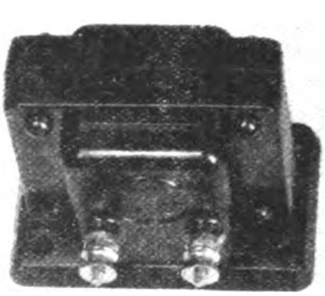
Outstanding features: The current-carrying capacity will take care of 80 milliamperes, which is more than adequate for average use. The use of sliders permits exact adjustment of the output voltages to meet the requirements of any receiver with which the power-pack is to be used. The sliders are so arranged that when their proper positions have once been found, they may be clamped into place by a turn of the insulated knobs.

Maker: Carter Radio Co.

A Compact Transformer for Small Receivers

Name of instrument: Low-frequency amplifying transformer.

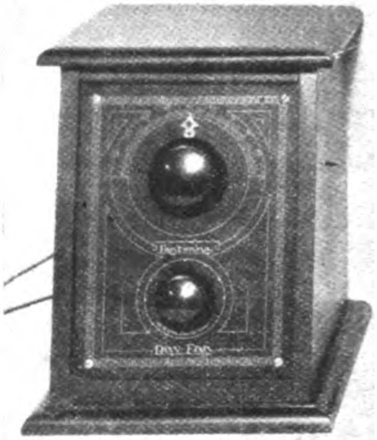
Description: This transformer is decidedly compact. It measures 2⅞ by 1⅞ inches, base dimensions, by 2½ inches in height. The windings and core are completely inclosed in a black composition case, with the four terminals brought out to binding posts which are located near the base of the instrument. Four holes are provided in the case for use in mounting the unit on a base.



Usage: As an intervalve coupling device in a low-frequency amplifier circuit.

Outstanding features: Compact size. Low price. Insulated case.

Maker: Pilot Electric Mfg. Co.



A Tuned Antenna Circuit for Your Receiver

Name of instrument: "Fantenna."

Description: A variometer and two variable condensers are included in a neat cabinet with a nicely decorated front panel. There are two control knobs with calibrated scales mounted on this panel, for use in tuning the device. The variometer and one of the variable condensers are mechanically coupled together to operate from a single knob. The other knob controls the remaining variable condenser. Three terminals are provided in the form of long wires which are to be connected to the antenna, ground and receiver.

Usage: To be connected between the antenna and the receiver to provide the advantages of a tuned antenna circuit.

Outstanding features: Neat in appearance. Provides greater signal strength and an ultra-sharp control over selectivity of reception.

Maker: Day-Fan Electric Co.

A New AC Operated Receiver Designed Especially for Family Use

Name of instrument: Zenith Model 17 receiver.

Usage: For the reception of radio broadcasting.

Outstanding features: Completely AC operated. Single-control tuning. Uses six standard vacuum valves. Contains no liquids and requires no attention to maintain. Complete in a console base or a spinet base, as desired.

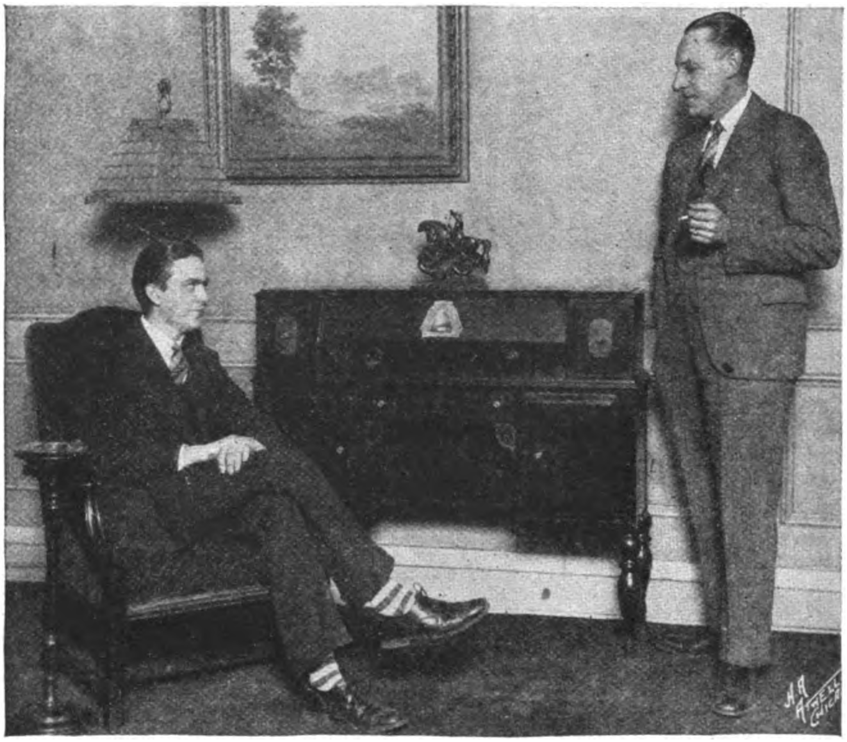
Description: This receiver is entirely self-contained, except for the antenna and reproducer. The power-pack equipment is in the receiver cabinet; so there is no necessity for having a base with drawers or closets, unless one wishes to have the reproducer inclosed. In that case a console with a built-in reproducer, as shown in the illustration above, is available to match this receiver.

The cabinet is of mahogany, with insets of bird's-eye maple. These latter are of a fairly dark shade, to blend easily with the darker mahogany and provide a most pleasing exterior. The spinet and console bases are finished in the same way, and when the receiver is assembled on one of these bases the two units take on the appearance of a single piece of furniture. The spinet base consists of four slender legs with a narrow top-rail.

Electrically, the receiver is carefully designed and executed. It is designed primarily for use as a home receiver and is extremely easy to operate, so that any member of the family can tune in the programs without the least difficulty.

The control panel contains a large knob for tuning to wavelength and a small knob for controlling the volume of reproduction. These two are the only controls used for ordinary reception. For out-of-town reception where the utmost in sensitivity is needed, there is a third knob, which brings the antenna circuit into exact resonance. As the tuning control knob is turned a calibrated scale passes beneath the small, illuminated window in the center of the front of the cabinet.

At either end of the receiver cabinet are two square compartments which are provided with doors that swing forward. The power-pack is in these compartments, the transformer and rectifier equipment at the right and the filter equipment at the left. All power is turned "on" by means of a four-position switch located behind the door of the right-hand compartment. To put the receiver into operation, this switch is turned to one of the four settings, which brings the hand of the meter on the receiver front to the position for correct operation; this position is clearly marked on the scale of this meter. Then the tuning control is turned until the setting shown on the tuning scale is correct for the station to which it is desired to listen. The volume is next adjusted to suit the listener. If the desired station is a distant one, it may be necessary to move the antenna tuning knob slightly.


THE NEW ZENITH 6-VALVE RECEIVER

The receiver is here shown mounted on the console base, with all the accessories incorporated in the cabinet. The reproducers are in the two lower square compartments and the power-pack in the two smaller compartments at the ends of the receiver cabinet.

The power-pack arrangement is unique in that it uses no storage battery, no charger and no liquid in any part of the rectifier or filter. And there is nothing that needs any attention on the part of the owner of the receiver. The rectifier consists of four Raytheon rectifier valves and operates through a filter that consists of the usual chokes and condensers. The use of the four rectifier valves, connected in parallel, provides sufficient direct current to operate the filaments of the UX-201-a type valves and also provides the current required by the plate circuits of the valves. This single power-pack provides the "A," "B" and "C" voltages required.

The receiver uses five UX-201-a type valves for the two high-frequency amplifier stages, the detector stage and for the first two low-frequency amplifier stages. The last low-frequency stage uses a power valve of the UX-171 type.

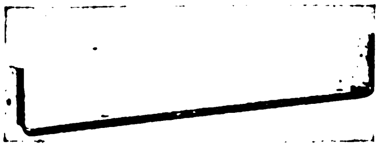
The ideal antenna for use with this receiver is an outdoor wire approximately 75 feet in length over all. A shorter antenna than this will produce excellent results, however, and an indoor antenna is all that is needed for local reception.

If a fine quality of reproduction is to be maintained, it is essential that a high quality reproducer be used. If the receiver is equipped with a Zenith console base, the question of reproducers is settled, because this console contains two reproducers. These are adjusted so that one reproduces the lower tones particularly well while the other reproduces the higher tones. Thus the two cover the entire musical range.

The sensitivity and selectivity of this receiver are excellent. During a test held in Chicago, and another in New York, a number of out-of-town stations were brought in while the local stations were going full blast.

For the man who wishes a radio receiver which his family can operate without any technical attention whatsoever, other than that of tuning in desired stations, and one which is fool-proof and absolutely safe even in the hands of a child, the Zenith receiver has much to recommend it—especially since these qualifications are coupled with fine quality of reproduction, good sensitivity and ample selectivity.

Maker: Zenith Radio Corp.



Brackets for the Sub-Panel Type of Receiver

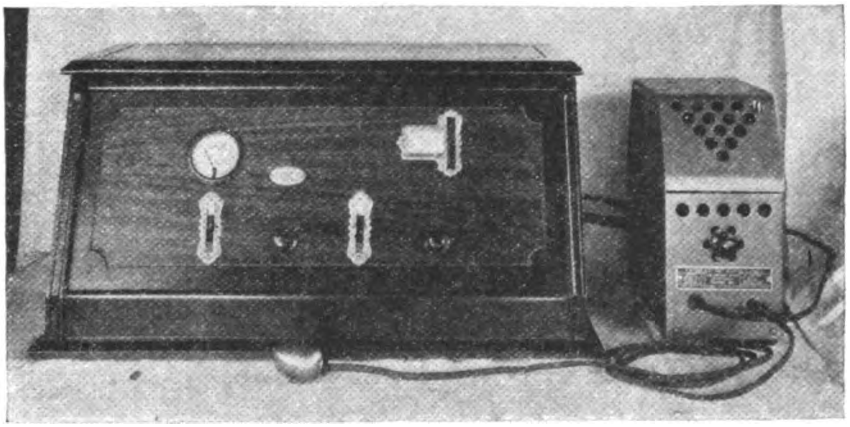
Name of instrument: Sub-panel bracket.

Description: The bracket pictured herewith is of heavy metal, ⅛ by ⅝ inch, and is heavily nickel plated. The over-all size of the bracket is 6 by 1 inch. Threaded holes are provided for attaching it to the front panel of the receiver and for attaching the sub-panel. These brackets are put up in sets of three, and when three are used to support the sub-panel they will provide excellent rigidity.

Usage: To be attached to the front panel of a receiver to furnish support for a sub-panel.

Outstanding features: Strong and durable. Drilled and tapped to accommodate mounting screws.

Maker: Karas Electric Co.



A Low-Priced, AC-Operated Receiver

Name of instrument: Crosley Model AC-7 receiver, equipped with the Crosley "ABC" power supply unit.

Usage: For radio broadcast reception.

Outstanding features: Requires no batteries. Low cost. Highly sensitive. Good selectivity. Neat appearance. Easy to tune.

Description: The AC-7 receiver is considerably more compact than the average 6-valve receiver. It is put up in an attractive cabinet that measures 21 inches in length by 12½ inches in depth by 11 inches in height. The cabinet is of mahogany, and is finished in a two-tone panel effect, with a gold pencil stripe between the panels and the darker border. All controls are mounted on the front panel of the receiver, which is also of mahogany. This panel slopes back from the base to permit clear vision and convenience of operation.

In addition to the AC-7, which is a table mounting model, there is also a console model which is known as the AC-7-C. This includes the same receiver as the AC-7 and also includes a built-in reproducer and space for the "ABC" power-pack. This description will be limited to the AC-7 model, inasmuch as the receiver units in the two models are identical.

Five of the vacuum valves used in the set are of the UX-199 type, with a UX-112 type valve for the last low-frequency amplifier stage. The receiver includes two stages of tuned-high-frequency amplification, a vacuum valve detector and three stages of transformer-coupled, low-frequency amplification. The input circuits are tuned by means of three variable condensers, which are mechanically coupled together to operate with a single control.

A metal sub-base serves as a foundation upon which the receiver is built up. It also serves the additional function of a shield. This sub-base is constructed like a box, open at the bottom, but with metal partitions separating the three high-frequency coupling coils, so that each is about three-quarters shielded from the others. All instruments except the milliammeter are securely mounted on this strong metal foundation. This practically precludes the possibility of connections working loose during shipment. It also aids materially in keeping the three variable condensers in alignment; although slight misalignment here would not be of extreme importance because of the flexible mechanical coupling between the condensers.

The circuit makes use of a special balancing scheme which provides great stability in the high-frequency circuits. Each receiver is balanced before leaving the factory and in this respect requires no attention whatsoever from either the dealer or the purchaser. This stability makes it possible to include regeneration in one of the circuits, with the result that the total high-frequency amplification is very high. The regeneration is under complete control of the operator at all times and can be increased or decreased at will by means of a small knob on the front panel. This is the famous Crosley "crescendon" feature.

The receiver is designed for use with the Crosley "ABC" power-pack. This design involves a special wiring of the valve filament circuits, *i. e.*, the filaments of the five UX-199 type valves are wired in series instead of the usual parallel method.

The "ABC" power-pack is not built into the receiver, but is a separate unit and is considerably smaller in size than the average storage battery. It supplies all voltages for the operation of the receiver. It consists of a transformer, a Raytheon-type BH rectifier valve, a suitable filter and the necessary resistances to provide the proper voltage distribution as required by this receiver. The 110-volt, 60-cycle, house-lighting supply provides the source of power for this unit, and the running cost amounts to only a few cents a week.

The power-pack is equipped with the necessary wires for connection to the receiver and to the AC supply line. There is also a switch on an extension cord, by means of which the current is turned "on" and "off." The entire power-pack is inclosed in a perforated metal case of neat appearance.

The tuning of the receiver is accomplished by means of a single control in the form of a knurled disc, the edge of which projects through a vertical slot in the front panel of the receiver. To this disc is attached a drum-type indicator scale that is calibrated in degrees. Two small auxiliary controls are provided. These are balancing controls rather than tuning controls and their function is to bring the three tuned circuits into resonance. Once this has been accomplished by tuning in a station and setting these two controls to provide maximum signal strength, then all other stations may be tuned in without further attention to these auxiliary controls. This applies to reception from local stations generally. In the case of extremely distant stations which require critical tuning, it may be necessary to resort again to the use of the auxiliary controls, but for average use this receiver will be found to function as a single-control set.

The meter on the panel enables the operator to maintain the right operating current at all times. The scale of this meter is calibrated in milliamperes with a section indicated in red. The pointer of the meter must be kept over this red marker for proper filament current supply and when so maintained there can be no damage to the valves from overloading the filaments.

The "crescendon" control mentioned before is found at the lower right-hand corner of the front panel. As this is turned to the right the sensitivity and selectivity of the receiver will be found to increase considerably.

An antenna for use with this receiver may be anywhere from 30 feet up in length. In locations where interference conditions are severe, the use of an antenna of around 30 feet in length will provide freedom from interference and the sensitivity of the receiver is such that an antenna of this length will give good all-around results. In out-of-town locations a longer antenna may be used.

In addition to its other good features, this receiver offers a particular appeal because of its low price. The receiver and "ABC" power-pack together sell for less than many of the standard receivers alone, and the upkeep cost of this receiver is almost negligible as compared with many of the battery-operated receivers.

A Quick Changeover Switch

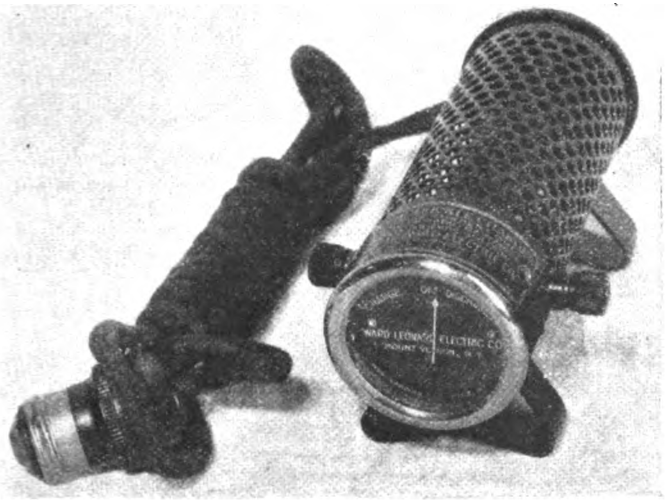
Name of instrument: Pole switch.

Description: The switch is mounted on a black composition base that measures 1¼ by 2¼ inches. The switch arms and contacts are neatly arranged. The contacts are made of stiff spring material and the arms are sufficiently heavy to insure ample rigidity and to maintain proper alignments. The arms and contacts are anchored to the composition base by means of screws which extend about ⅜ inch beyond the bottom of the base. This permits the mounting of the switch on a panel, if desired, with the connections from the switch made to the screws that extend through the panel.

Usage: For use at any place where a knife switch is needed.

Outstanding features: Compact. Neat. Good contacts.

Maker: Frank W. Morse Co.



A Direct-Current Storage Battery Charger

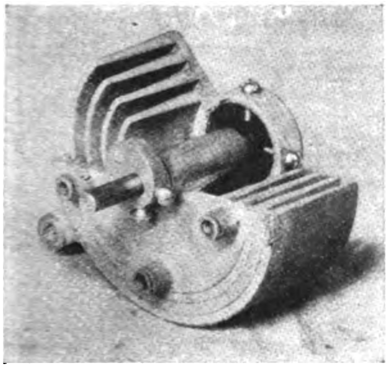
Name of instrument: Vitrohm trickle charger.

Description: This charger consists of a "Vitrohm" resistance unit which is inclosed in a cylindrical metal case. This case is perforated to allow free circulation of air while the charger is in service, at which time it gives off considerable heat. The mounting feet hold the instrument well off the table or floor for this same reason. A meter is included in one end of the case to indicate when the charger is functioning, and also to indicate the polarity of the connections. Two binding-post terminals are mounted on the sides of the case for connection to the terminals of the battery under charge, and the charger is equipped with a 6-foot extension cord and plug for connection to the 110-volt, *direct-current* lighting lines. This unit may be used to trickle charge batteries from 2 to 80 volts, and the charging rate varies from .3 ampere to .1 ampere, depending on the voltage of the battery. A standard 6-volt storage battery will be charged at the rate of approximately .3 ampere per hour.

Usage: For charging storage batteries from the DC house-lighting lines.

Outstanding features: Well insulated. Reliable and long-life resistance unit. Well ventilated. Equipped with an indicating meter.

Maker: Ward Leonard Electric Co.



A Variable Capacity Unit That Is Highly Efficient

Name of instrument: Variable condenser.

Description: This unit is of entirely different construction from that of the usual types of variable condensers, as shown in the illustration herewith. Instead of the plane of the plates being at right angles to the length of the shaft, it is parallel to the length of the shaft. The rotor and the stator sections are each molded in a single piece. This is sure to guarantee uniformity. The rotor section is insulated from the stator section and from the shaft itself. The design is such that the insulating material used is extremely small. The single bearing is over an inch in length and presents no opportunity for working loose or becoming wobbly. Contact with the rotor section is obtained through a phosphor-bronze spring which presses firmly against the end cap of the rotor unit.

Usage: As a variable capacity unit for use in any tuned circuits, or for any other purpose that is served by a standard variable condenser.

Outstanding features: Low minimum capacity. Minimum high-frequency resistance. Low dielectric losses. Shaft grounded to stator unit and rotor entirely isolated.

Maker: Unitrol Condenser Corp.

A Unit to Protect Your Reproducer

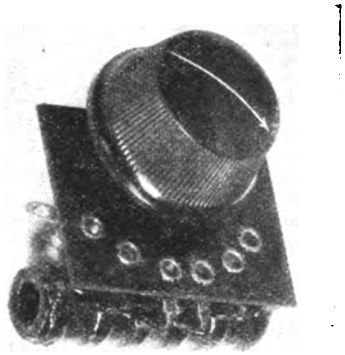
Name of instrument: Output filter.

Description: This unit consists of an impedance coil and a high-voltage, high-capacity fixed condenser. These are assembled in a metal box which is then filled with wax. An extension cord is provided, one end of which is connected inside of the filter unit; the other end is equipped with phone tips for connection to the output of the receiver. The output terminals of the filter are in the form of phone-tip jacks and are mounted on a composition strip at one end of the filter case. The case is finished in grey and is provided with drilled flanges at the bottom, for use in mounting the instrument.

Usage: To be connected between the output of any receiver which uses a power valve in the last low-frequency stage, and the reproducer. The purpose of the filter is to separate the direct current from the alternating current in the output of the receiver, and to permit only the alternating-current component to pass through the windings of the reproducer. The direct current, which serves no useful purpose in the reproducer, passes through the impedance coil in the filter unit and back to the receiver. The advantage of this arrangement is apparent when it is remembered that with power valves in the last low-frequency stage, the current flowing in the plate circuit may run as high as 30 milliamperes, and is sufficient in some cases to burn out the reproducer windings.

Outstanding features: Compact and rugged. Protects the reproducer windings. Often improves the quality of reproduction because it removes unnecessary strain from the reproducer unit and matches up the output impedance of the power valve and the reproducer impedance.

Maker: Paragon Electric Corp.



A Variable Detector Voltage from "B" Power-Packs

Name of instrument: Tapped resistor with tap-switch.

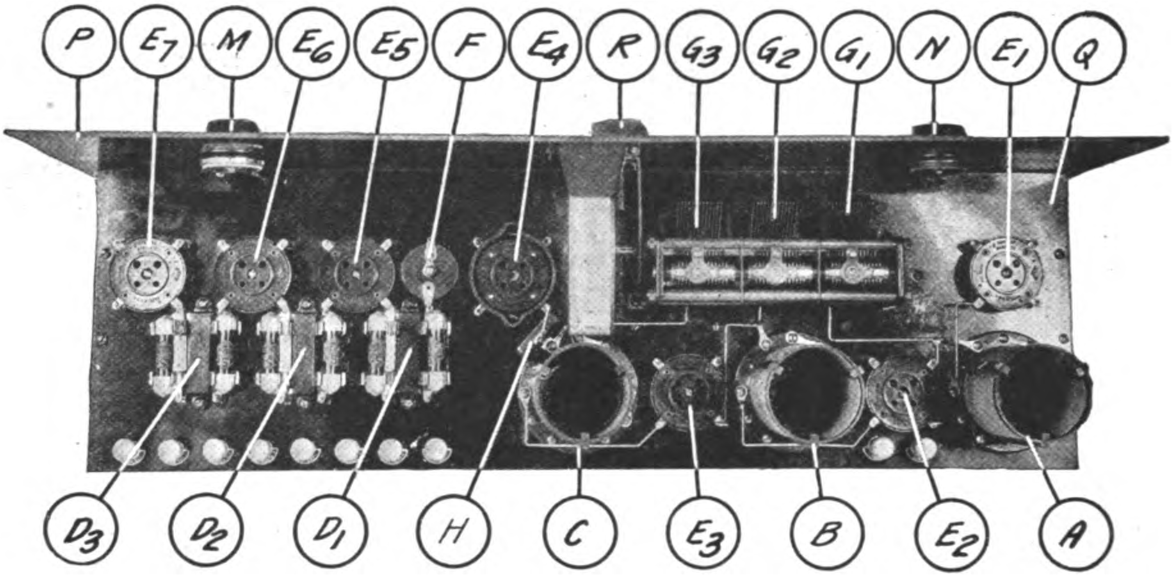
Description: This resistor consists of a "Kroblack" unit with a total resistance of approximately 30,000 ohms, and is tapped to provide suitable variations in resistance. These taps are brought out to rivet-studs on a small composition panel, on which is also mounted a switch to make contact with any desired stud.

Usage: Wherever a tapped resistance of 30,000 ohms is required. Especially intended for use in the output circuit of a "B" power-pack, in series with a fixed resistance, to provide variable voltage for the detector plate supply.

Outstanding features: Small in size. Adequate current-carrying capacity for the use specified. Good contact. Reliable resistance units.

Maker: C. E. Mountford.

¶ *The set builder who is looking for simplicity in construction and operation, along with high quality reception, will find this receiver an exceptional value—at a very low price.*



THE RECEIVER AS IT LOOKS FROM ABOVE

FIGURE 1: *The mechanical layout of this receiver is extremely simple and logical. At the right of the single-control drum dial is the high-frequency amplifier section of the receiver, and at the left of the drum are arranged the detector and the three stages of resistance-coupled, low-frequency amplification. Note the simplicity of the above panel wiring connections.*

HOW TO BUILD

THE AERO 7 RECEIVER

Here is an exceptionally satisfactory receiver that embodies the principle of high-mu amplification in both the high-frequency and the low-frequency amplifiers. Although actual single control is employed, the tuning of the receiver is very sharp, and resistance-coupled stages in the low-frequency amplifier give reproduction of excellent quality.

By ZEH BOUCK

COST OF PARTS: *Not over $60.00*

HERE IS A LIST OF PARTS NECESSARY FOR BUILDING THIS RECEIVER—

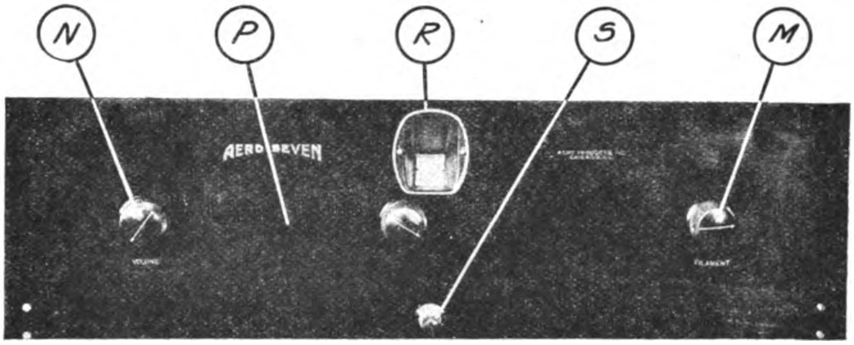
A, B and C—Aero tuned, high-frequency kit of 3 coils, Code U-12;
D1, D2 and D3—Amsco resistance-coupled amplifier, "Aero Seven" kit;
E1, E2, E3, E5, E6 and E7—Amsco plain sockets;
E4—Amsco floating socket;
F—Aero choke coil, No. 60;
G1, G2 and G3—Amsco triple variable condenser, each section .0005 mfd.;
H—Carter .00025 mfd. fixed condenser;
I and J—Carter .5 mfd. by-pass condenser;
K—Carter resistor, type H-1000;
L—Amsco grid gate, 5 megohms;
M—Carter "Imp" rheostat, 6 ohms;
N—Carter "Imp" potentiometer, 200 ohms;
O—Carter filament resistor, type H-1;
P—Aero front panel, drilled and engraved;
Q—Aero sub-panel, drilled;
R—Silver-Marshall drum dial, complete;
S—Carter battery switch;
T—Amsco grid gate mounting;
U1, U2, U3, U4, U5, U6, U7, U8, U9 and U10—XL binding posts;
V1 and V2—Aero sub-panel brackets;
W—Carter .001 mfd. fixed condenser;
Bus wire, solder, screws, etc.

THERE are many prospective set builders who have heard their neighbors' home-built receiving sets and marveled at the excellence of the tone quality that they are able to get, as well as the simple operation and the beautiful appearance of some of these sets. However, quite a number of these would-be builders refrain from building their own sets because they believe it is beyond their comprehension, and too complicated an affair for them to make.

This receiver, in spite of the fact that it utilizes seven valves, which give it great sensitivity and volume, is exceptionally well suited for the home set builder who is a novice, but who wants to get the most for his money. The receiver may be built with absolutely no previous knowledge of radio and without other directions than those following in this article.

The first three valves of the receiver are high-frequency amplifiers, and are coupled to three tuned circuits. The input circuit in untuned, using a fixed resistance to furnish the necessary voltage drop across the filament-grid circuit. The detector valve, as well as each of the first three valves, is a high-mu valve, and it is coupled to the input circuit of three stages of efficient resistance-coupled, low-frequency amplification, using a UX-171 type valve in the last stage, either a UX-112 type of valve or a UX-201-a type of valve in the second stage, and either a UX-240 or a UX-201-a type of valve in the first stage. The controls on the panel consist of a single knob for tuning, a potentiometer knob for stabilizing, and a series resistance knob for controlling the amount of amplification obtained in the three high-frequency valves.

The set, as tested out in the POPULAR RADIO Laboratory and in various other parts of New York and Chicago, proved to be adequately selective for tuning through the locals and bringing in distant stations with plenty of volume and without interference. The set is exceptionally easy to wire and construct, and will repay anyone for his trouble, whether he be an experienced set builder or a novice.



THE FRONT PANEL OF THE RECEIVER

FIGURE 2: *In the center is the drum dial, R; below it and slightly to the left is the knob that controls it. At the bottom of the panel, at S, is the filament switch. The controls, M and N, are for the regulation of the volume and filament current. The panel may be bought already drilled and engraved, thus saving the builder much uninteresting work.*

How to Construct the Receiver

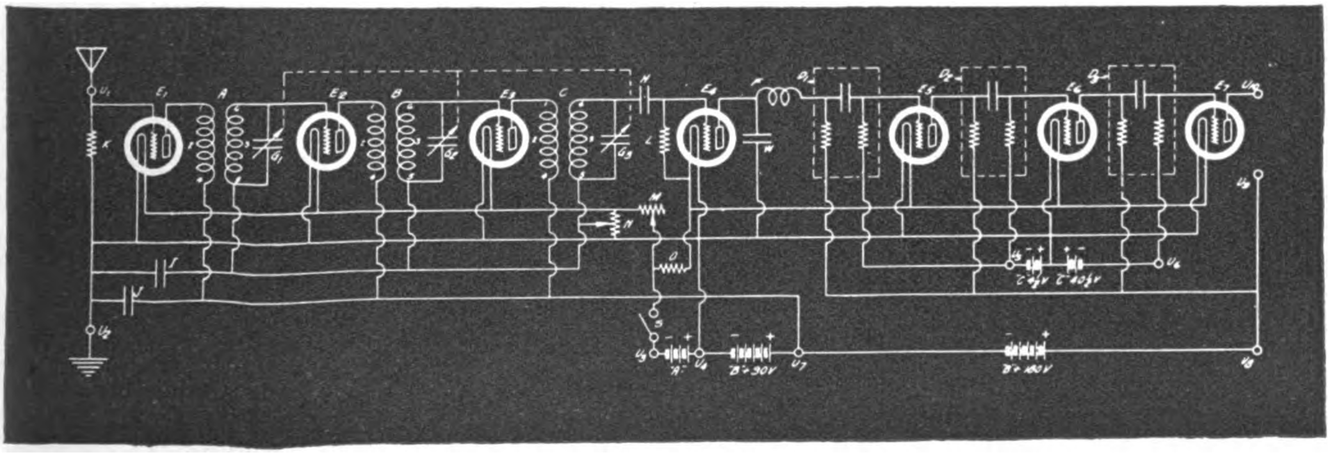
The front panel and the sub-panel are furnished cut to size and completely drilled; thus the most uninteresting work of receiver construction is eliminated. Holes are also provided for everything, and it is only necessary for the constructor to place the individual instruments in the positions shown in Figures 1, 4, 5 and 7. The mounting holes in the panels correspond exactly with the mounting holes in the instruments themselves.

Some of the mounting screws serve the dual purpose of attaching two instruments at once, one on the top of the sub-panel and the other beneath the panel. All such screws are indicated in the picture wiring diagrams, Figures 4 and 5, by a number that is prefixed by the letter X. In Figure 4, for instance, the mounting screw for the valve socket E1 is marked X1. Reference to Figure 5 shows that the resistance unit K is mounted on the under side of the sub-panel by means of this same screw.

A start can be made by mounting the few parts that belong on the front panel. These consist of the rheostat M, the potentiometer N, the switch S and

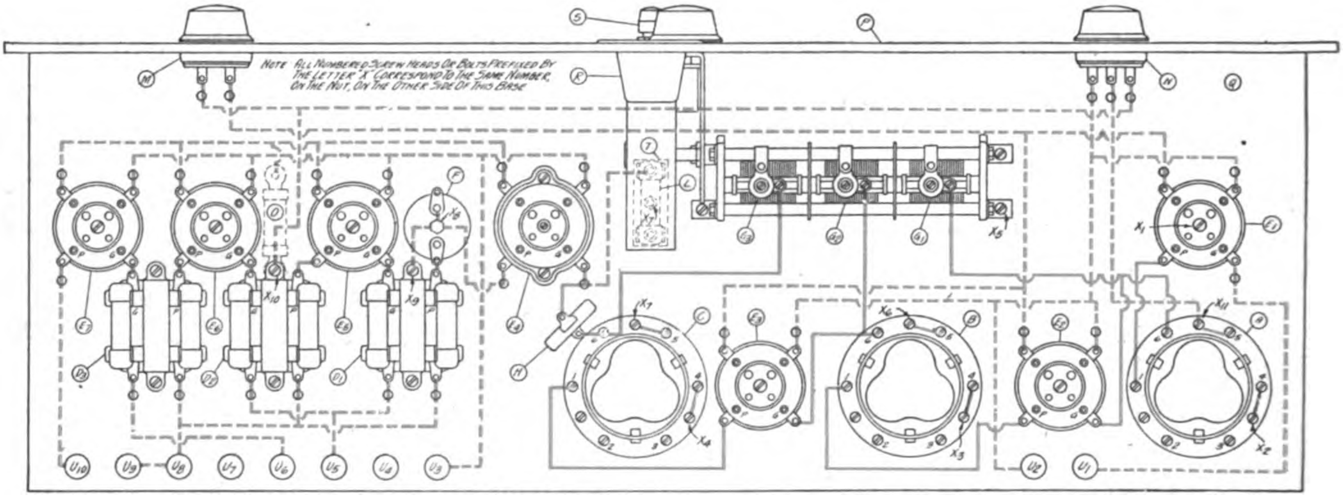
---

¶ *The list of parts given on page 140 includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE SCHEMATIC DIAGRAM OF THE CIRCUIT EMPLOYED

FIGURE 3: *In this theoretical hook-up of the receiver, notice that the antenna circuit, at the extreme left, is untuned, and that the three following stages of high-frequency amplification are tuned by a triple condenser, indicated by the dotted lines connecting the condensers, G1, G2 and G3. The low-frequency amplifier is at the right.*


NOTE ALL NUMBERED SCREW HEADS OR BOLTS PREFIXED BY THE LETTER "X" CORRESPOND TO THE SAME NUMBER, ON THE NUT, ON THE OTHER SIDE OF THIS BASE
V10
V9
V8
V7
V6
V5
V4
V3
V2
V1

THE PICTURE WIRING DIAGRAM OF THE CONNECTIONS ABOVE THE SUB-PANEL

FIGURE 4: *The instruments are outlined in* BLACK. *The solid* RED *lines indicate the wiring connections to be made above the sub-panel. The dotted* RED *lines indicate wires that have terminals or connections on the upper side of the sub-panel, but that run underneath the sub-panel.*

the tuning control and plate R. Figure 2 shows the arrangement of these instruments. The front panel may then be set aside while the instruments are mounted on the sub-panel.

The brackets V1 and V2 should be mounted first, on the under side of the sub-panel. This will serve to keep the sub-panel up off the work bench and protect the instruments which are later mounted on the under side of this panel. Then proceed with the mounting of the other instruments. It is wise to mount all of the small instruments first, because if the coils and the gang condenser are mounted first there is the possibility that they may be damaged from excessive handling as a result of a tool slipping.

As may be seen in Figure 7, the soldering lugs are fastened under some of the nuts on the under side of the panel. Time will be saved if these lugs are attached while the instruments are being mounted.

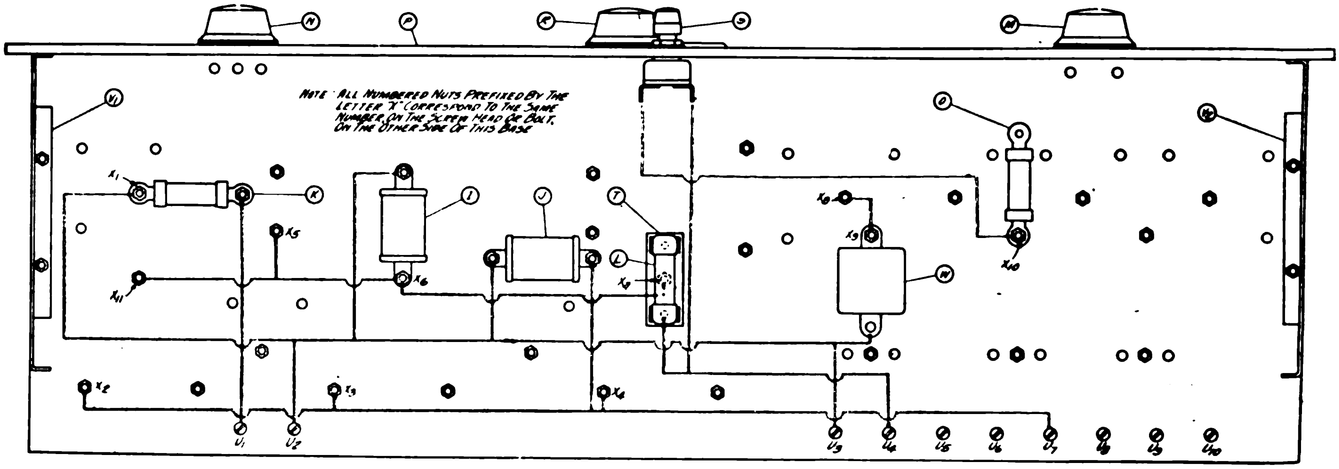
How to Wire the Receiver

When all of the parts have been mounted on the front panel and on the sub-panel, the wiring may be started. Much of the wiring can be completed before the front panel is attached to the sub-panel and it is recommended that this course be followed because the manipulation of the soldering iron can proceed unhampered.

All of the connections shown in the picture wiring diagram of the under side of the panel, Figure 5, may be made first, with the exception of the two wires which connect to the switch S. These two connections are left until after the front panel has been attached. Then the wiring shown by solid lines in the picture wiring diagram of the top of the sub-panel, Figure 4, can proceed.

The wiring that is shown by broken lines in Figure 4 represents wires that have one or more terminals above the panel, but which are carried down through holes in the sub-panel to run along underneath for the sake of concealment. This method improves the appearance of the receiver when viewed from above.

It will be noted that in a number of cases connections are made without the use of wire. The grid and plate terminals of the resistance coupling units D1 and D2, for instance, are connected direct to the corresponding terminals


NOTE ALL NUMBERED NUTS PREFIXED BY THE LETTER "X" CORRESPOND TO THE SAME NUMBER ON THE SCREW HEAD OR BOLT, ON THE OTHER SIDE OF THIS BASE
V1
V2
V3
V4
V5
V6
V7
V8
V9
V10

THE PICTURE WIRING DIAGRAM OF THE PARTS MOUNTED UNDER THE SUB-PANEL

FIGURE 5: *The instruments are outlined in* BLACK. *The heavy* RED *lines indicate wires that are run entirely on the bottom side of the panel. The lettering on some of the mounting screws corresponds with lettering in Figure 4, and indicates screws that serve a purpose on both sides of the panel.*

of the valve sockets and the choke coil F, by means of their soldering lugs.

All of these "wireless" connections can be made at the same time as the other solid, above panel connections. Following this, the connections shown by the dotted lines should be made, with the exception of those that connect to instruments on the front panel.

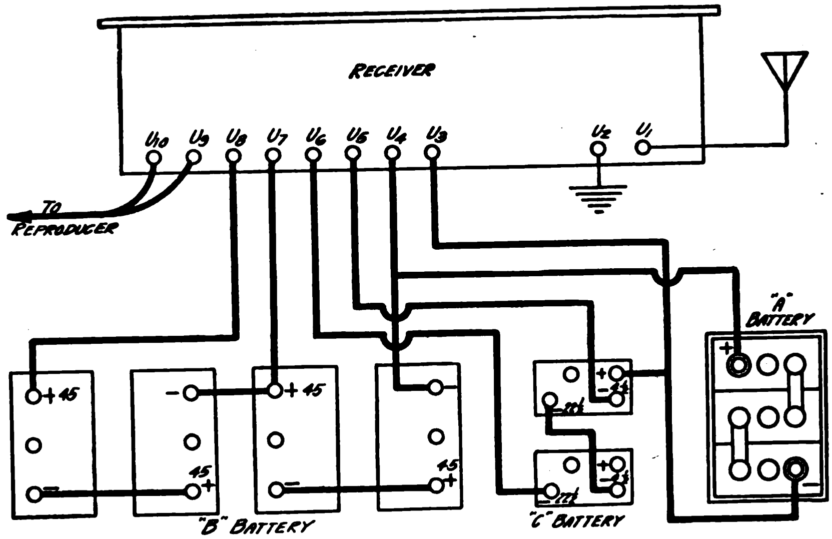
With the wiring completed to this point, the front panel may be attached to the sub-panel. This is accomplished by means of four bolts inserted through the front panel and the corresponding holes in the brackets V1 and V2. The drum control is attached and adjusted at this time to make sure that this tuning control equipment is all functioning properly.

The instruments on the front panel can now be wired; this completes the construction of the receiver.

How to Install the Receiver

The detailed connections for the antenna, ground, batteries and reproducer are shown in Figure 6. These are the connections for use when a CX-171 or a UX-171 type valve is to be used in the last low-frequency stage (valve socket E7). The use of this type of power valve is recommended because valves of the UX-201-a or UX-112 type are not capable of handling the power produced by this receiver when turned up "full."

Before inserting the valves in their sockets be sure that the switch S is turned to the "off" position and that the rheostat M is also "off." These precautions should also always be followed in removing one or more valves from this receiver, as the removal of one valve results in increased voltage being applied to the filaments of the other valves, all of which draw their filament current through the same resistance or rheostat.



HOW TO HOOK UP THE RECEIVER

FIGURE 6: *This figure shows the proper connections to be made to the "A," "B" and "C" batteries. The first two binding posts, U1 and U2, connect with the antenna and ground, while the last two, U9 and U10, are for the reproducer cord.*

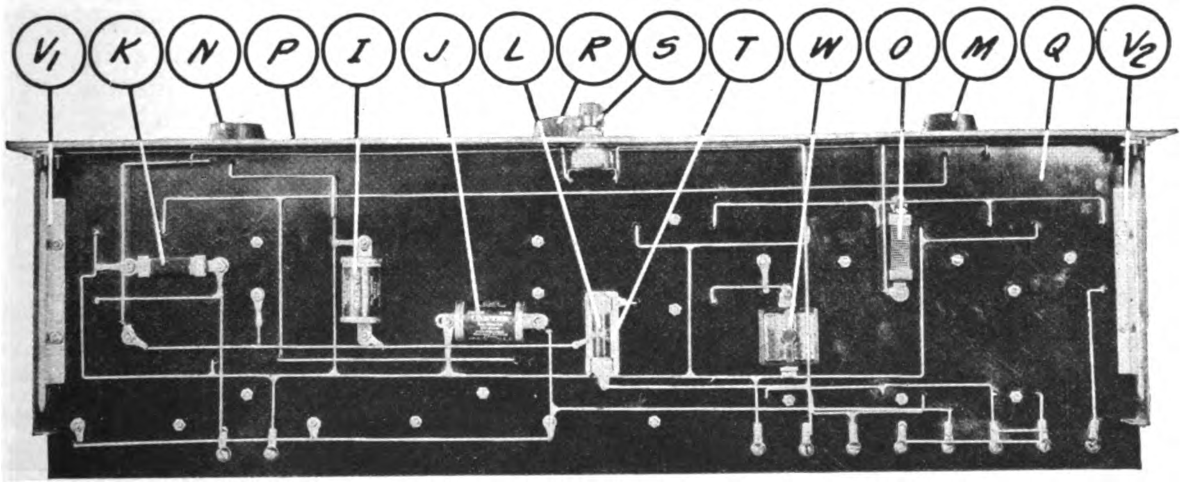
High mu valves such as the CX-340 or the UX-240 should be inserted in the sockets E1, E2, E3 and E4. In socket E5 either a UX-240 type valve or one of the UX-201-a type may be used. The former will provide somewhat greater volume but the latter is somewhat more satisfactory in general. Either a UX-201-a type valve or a UX-112 type is used in E6 and in E7 a power valve of the CX-171 or UX-171 type is required.

How to Operate the Receiver

There are no tricky neutralizing or balancing adjustments to be made in the high-frequency circuits of this receiver. When the batteries, antenna, ground and reproducer have been connected up and the valves inserted in their sockets the receiver is "ready to go." With the control knob of the rheostat M turned half way "on" the switch may be turned "on." All of the valves should now light up. The tuning control knob should next be turned slowly until the signals from a broadcasting station are heard and the station tuned in loudest by careful adjustment of this tuning control and of the knob that controls the potentiometer N. The rheostat can then be adjusted to a point where the reception is loudest. This should not be higher than three quarters of a turn in a clockwise direction.

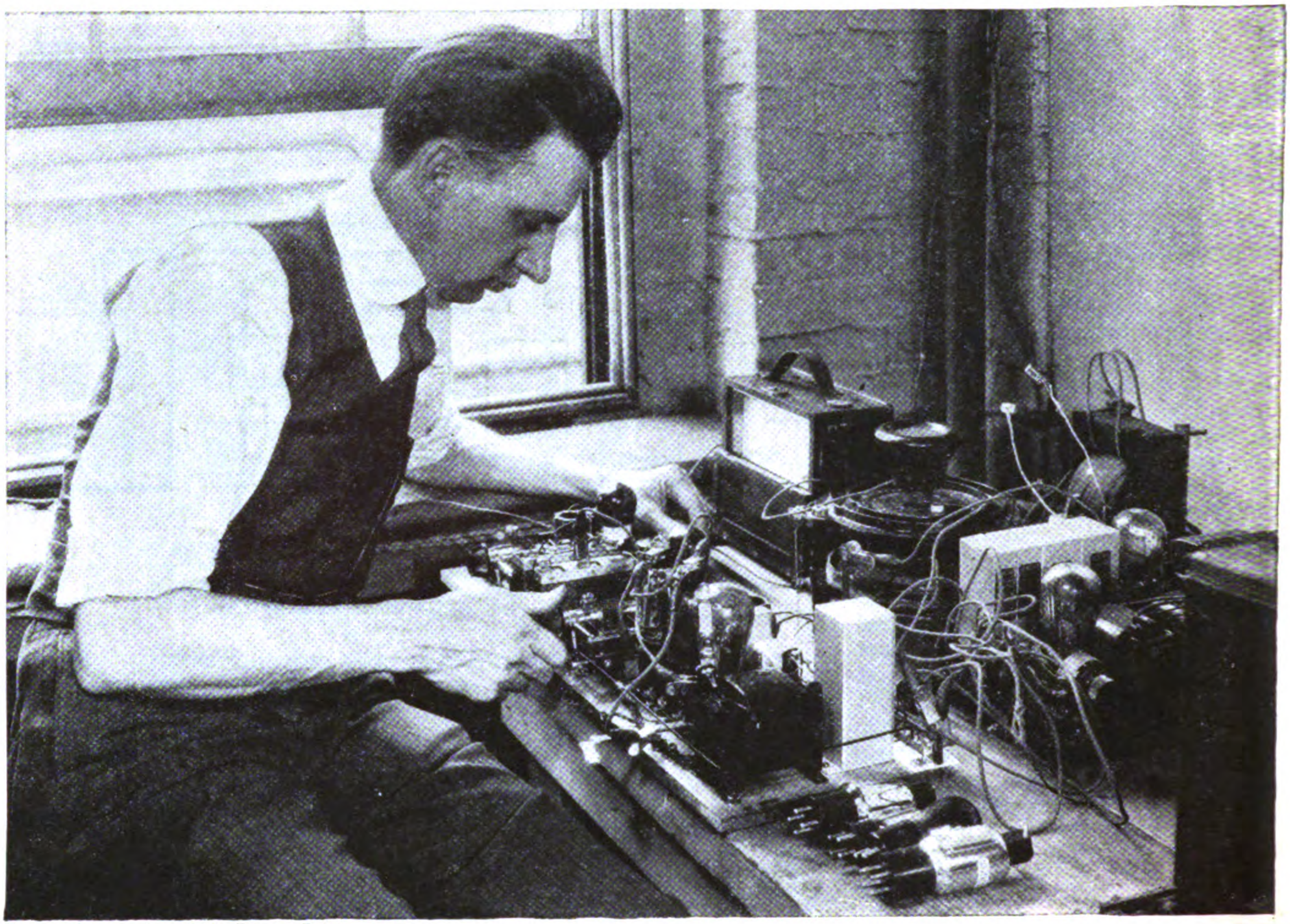
For reception from local stations the potentiometer can be adjusted to one position and left that way indefinitely.

Even in the case of long distance reception the operation is almost as simple, as this involves only the additional adjustment of the control N. The tone quality obtained should please the most critical ear.



A VIEW OF THE SET FROM BELOW

FIGURE 7: *Some of the screws used for mounting instruments on the top of the sub-panel hold soldering lugs underneath. These are clearly shown in this view of the receiver.*



From a photograph made for POPULAR RADIO

A HIGHLY SUCCESSFUL AC VALVE RECEIVER

FIGURE 1: *This set was developed in the* POPULAR RADIO LABORATORY *by Mr. Albert G. Craig. It is equipped throughout with AC valves and operates entirely from the lighting lines. Its output with AC valves is greater than with the use of standard battery valves.*

PRACTICAL HINTS FOR OPERATING

The New AC Valves

POPULAR RADIO was the first magazine to introduce to the radio public the AC valves and the AC operation of radio sets in general. It is peculiarly fitting, therefore, that it should now conduct, in co-operation with leading manufacturers, a series of experiments and tests of all devices that are suitable for operation with AC valves and of devices designed to operate standard valves from the house lighting lines. The Technical Staff of POPULAR RADIO believes that the advance information obtained in this research work is of such widespread importance to the radio experimenter and to the professional set builder that it is releasing it in installments—of which this is the first.

By ALBERT G. CRAIG

SOME of our readers may remember the June, 1925, issue of POPULAR RADIO, in which was described, for the first time, a radio receiver that employed AC valves that worked entirely from the lighting lines without batteries.

This receiver created a great deal of general interest. Some of the radio experimenters who did not try it rather scoffed at the idea of an AC tube. It was "too far ahead of the times," they said. To them it might be of special interest to learn here that the original receiver from which the description in POPULAR RADIO was made is still in good working condition and is giving satisfactory service with the same valves with which it was first equipped.

Now a number of manufacturers are making vacuum valves of this general type. Set builders in general, therefore, will be interested in the two AC-operated outfits that are described in this article.

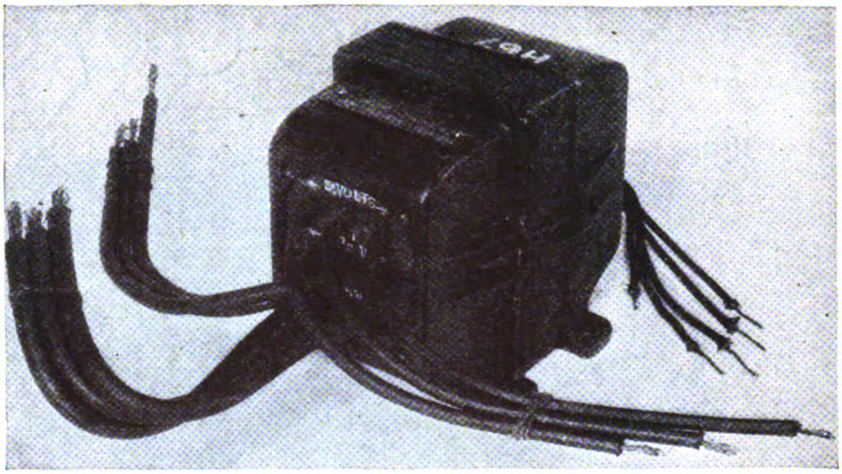
To begin with, there are two types of AC tubes; both of them have a regular grid and plate design similar to that found in standard storage-battery valves.

One of these types, known as the "raw AC" type, has an oxide-coated filament and is operated with a potentiometer connected across the filament, with the center point connected to the grid return.

This type of valve is suitable for high-frequency amplification and (in some cases) for the first stage of low-frequency amplification. It is not generally used as a detector.

Under this general type of valve fall the new Radiotron UX-226 type valve (which is exactly similar to the CX-326), the Van Horne AC valve, the Armor valve and a few others.

The second type of AC valve, of which the McCullough valve was the pioneer on the market, includes such valves as the McCullough, the UX-227 (which is exactly similar to the CX-327), the Sovereign AC valve and others.

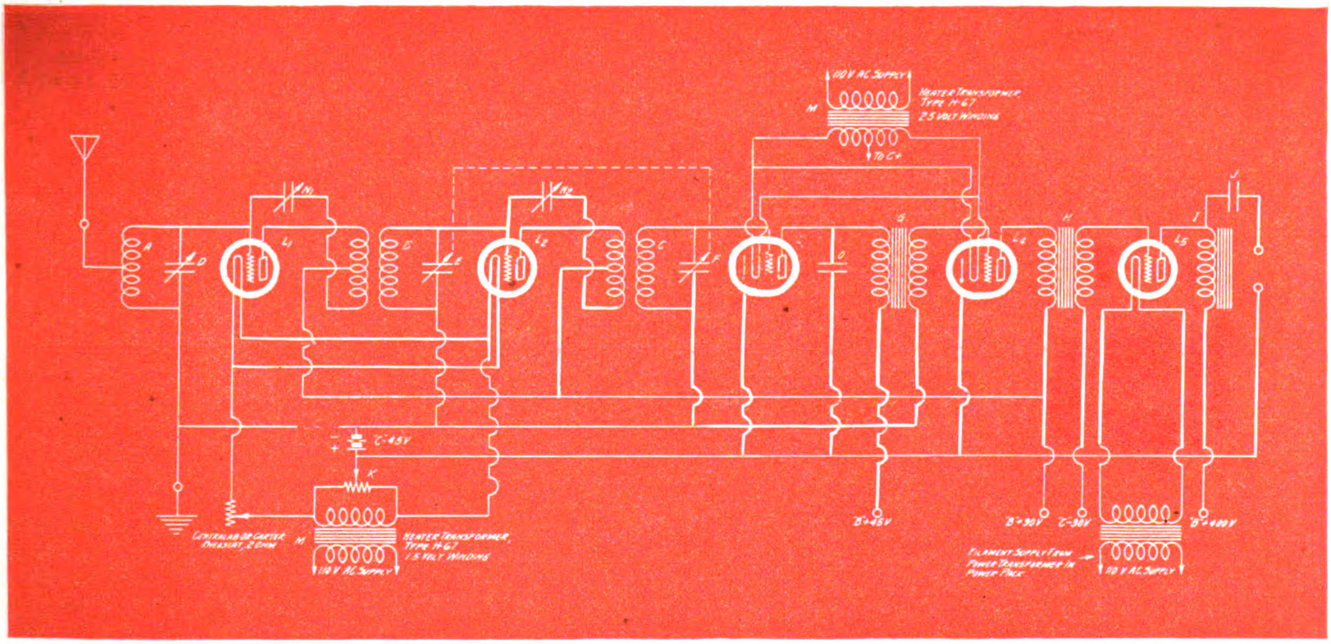


A FILAMENT LIGHTING TRANSFORMER

FIGURE 2: *The new H-67 type of heater transformer, shown above, steps down current from the lighting lines for operating the filaments or heaters of any type of AC valve. Each of the three sets of wires at the front end of the unit consists of two filament wires and a center tap.*

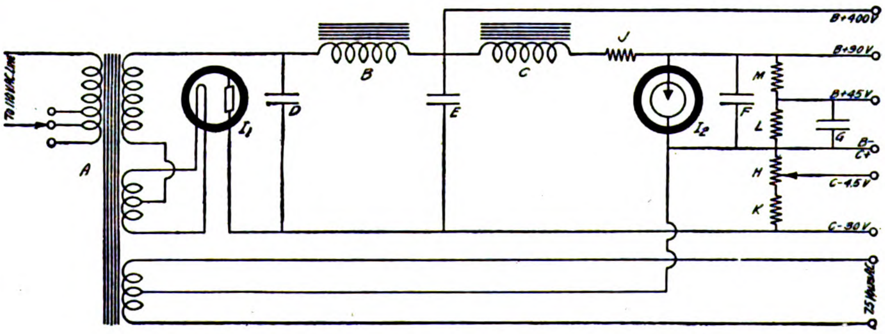
This latter type of valve contains a "heater" that is independent of the "cathode," which corresponds to the "filament" in a storage-battery valve. In this latter type, the hum, when used as a detector or as a first-stage low-frequency amplifier, is greatly reduced, if not entirely eliminated.

The first experimental set-up utilizes two of the "raw AC" types of valves and two of the "isolated cathode" type of valves, as well as a UX-210 type of


110 V AC SUPPLY
HEATER TRANSFORMER TYPE H-67 2.5 VOLT WINDING
M
TO C+
A
B
C
D
E
F
G
H
I
J
N1
N2
L1
L2
L4
L5
C-4.5V
K
B+45V
B+90V
C-30V
B+400V
CENTRALAB OR CARTER RHEOSTAT, 2 OHM
HEATER TRANSFORMER TYPE H-67 1.5 VOLT WINDING
110 V AC SUPPLY
FILAMENT SUPPLY FROM POWER TRANSFORMER IN POWER PACK
110 V AC SUPPLY

THE SCHEMATIC DIAGRAM OF AN AC CIRCUIT

FIGURE 3: *Above is the circuit employed in the set shown in Figure 6. Although the transformer, M, occurs twice in the diagram, a single transformer with two secondary windings is used.*



THE WIRING SCHEME OF A POWER-PACK FOR AC SETS

FIGURE 4: *At the right is shown the wiring scheme for the power-pack illustrated in Figure 5, that is used to supply energy to the receiver shown in Figure 6.*

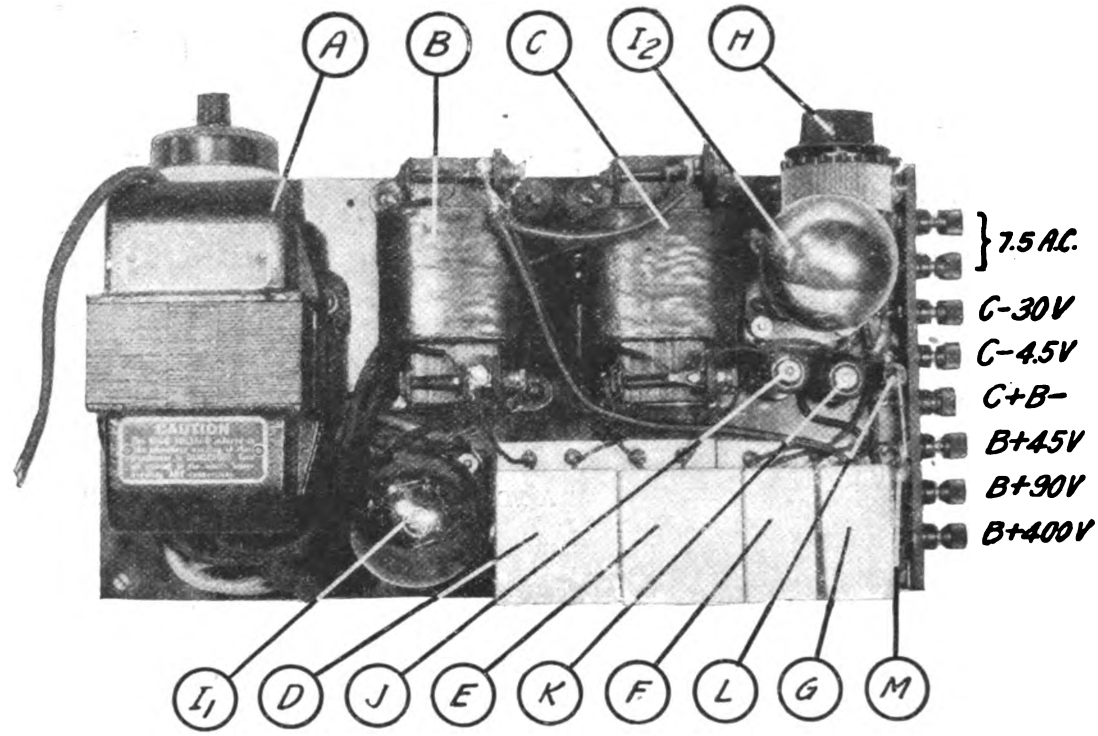


FIGURE 5: HERE IS A LIST OF PARTS FOR THE CONSTRUCTION OF THE AMERTRAN POWER-PACK—

A—AmerTran power transformer, type PF-52;
B and C—AmerChokes, type 854;
D—Aerovox filter condenser, 2 mfds. for 600 volts DC;
E—Aerovox filter condenser, 4 mfds. for 400 volts DC;
F and G—Aerovox filter condensers, 2 mfds. for 400 volts DC;
H—Frost variable resistance, 400 ohms;
I1 and I2—Benjamin Cle-Ra-Tone vibrationless sockets;
J—Ward-Leonard vitrohm resistance, 12,000 ohms;
K—Ward-Leonard vitrohm resistance, 300 ohms;
L—Allen-Bradley fixed resistance, 7,500 ohms;
M—Allen-Bradley fixed resistance, 12,000 ohms;
1 bakelite binding-post strip, 7 by 1 by 3/16 inch;
1 composition baseboard, 13½ by 7 by ¼ inch;
1 UX-216-b rectifier valve;
1 UX-874 voltage-regulator valve;
2 angle brass brackets, ⅝ by ⅝ by 1/16 by 13½ inches;
8 Eby binding posts;
Wire, screws, etc.

---

valve, the filament of which is operated on alternating current.

In Figures 1 and 6 is shown a successful set-up experimented with in the POPULAR RADIO LABORATORY.

The parts and instruments are designated with letters that correspond with the list of parts used in the experiment.

The schematic wiring diagram, that gives the correct circuit for this set-up, is given in Figure 3. In Figures 4 and 5 is shown the power-pack that operates this receiver.

The lettering in Figure 3 corresponds with the lettering in Figure 6 and the list of parts below it, so that the experienced radio fan will be able to duplicate it and get the same results. Such a set-up may be built according to the set builder's fancy into a cabinet or console. The parts should be arranged in a similar manner to that shown in Figure 6 for the best results.

This set gives more volume and better quality with AC-valve operation than is possible with the use of storage-battery valves. It operates entirely on the alternating-current lighting lines, and when once properly adjusted it should function for years without any extra expense, except for the small charge for power taken off the line.

There are no storage batteries to charge or run down.

Another type of AC set that has worked out favorably in experiments in the POPULAR RADIO LABORATORY is shown in Figures 8 and 9.

All the parts used in the "ABC" power-pack shown there are also designated by letters that correspond to the accompanying list of parts and to the schematic wiring diagram that is given in Figure 7. This unit relies upon a high-current rectifier valve similar to that made by the Q. R. S. Music Company. This type of valve will rectify enough energy to light the filaments of storage-battery valves, connected in series, as well as supply "B" and "C" potentials for necessary operation.

The set with which this scheme is to be used must have the filaments wired in series accordingly. The general scheme of series winding for filaments may be understood by studying the diagrams on page 526 of the June number of POPULAR RADIO.

Any four-, five- or six-valve sets may be operated on this principle, and any similar receiver may be converted to this method of operation easily by changing the filament wiring to accomplish this purpose.

This method of AC set operation has been found entirely satisfactory throughout extended use in the Laboratory, and may be built into an old set or into a new one. It is not difficult

---

¶ *The lists of parts given in this article include the exact instruments used in the apparatus from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *627 West 43rd Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

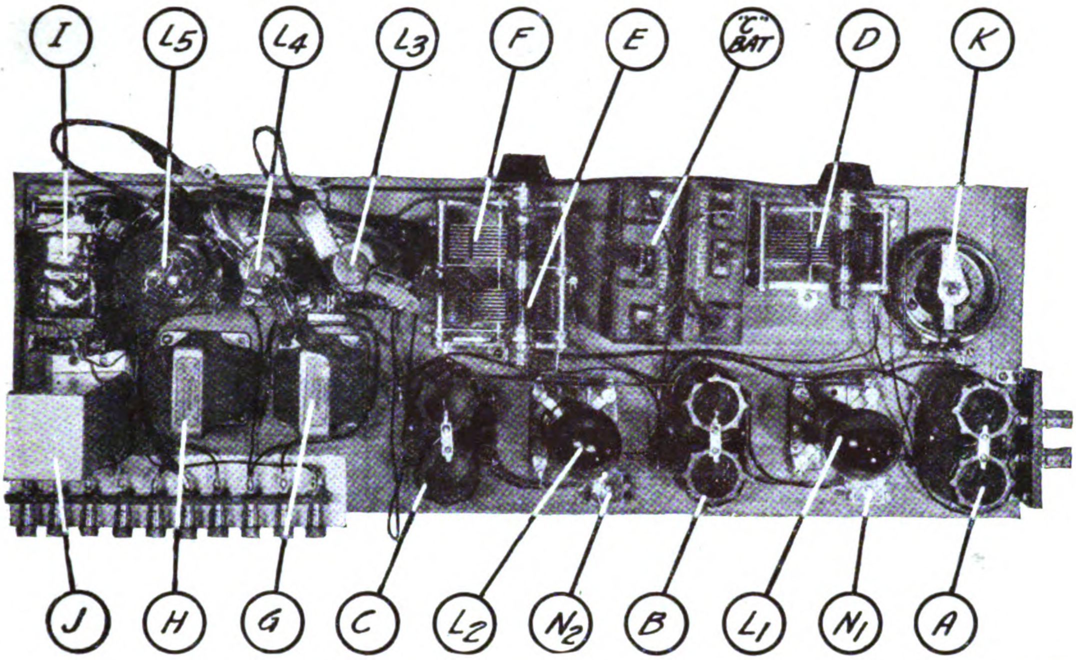


FIGURE 6: HERE IS A LIST OF PARTS NEEDED FOR THIS BATTERYLESS SET THAT USES AC TUBES—

A, B and C—Camfield high-frequency coupling coils;
D—Camfield Equaltune condenser, .00035 mfd.;
E and F—Camfield Equaltune double condenser, .00035 mfd. each;
G and H—Samson Symphonic low-frequency transformers;
I—AmerChoke No. 854;
J—Aerovox high-voltage filter condenser, 2 mfds.;
K—General Radio potentiometer, 20 ohms;
L1 and L2—Airgap sockets;
L3, L4 and L5—Benjamin Cle-Ra-Tone vibrationless sockets;
M—AmerTran transformer, type No. H-67 for filament heating;
N1 and N2—Hammarlund balancing condensers;
O—Dubilier fixed condenser, .0005 mfd.;
12 X-L binding posts;
1 bakelite strip, 3½ by 1 by 3/16 inch;
1 bakelite binding-post strip, 8 by 1 by 3/16 inch;
1 wooden baseboard, 9 by 26 by 7½ inches;
4 small brass brackets for mounting binding-post strips;
2 "C" batteries, 4½-volt;
2 Van Horne AC valves;
2 McCullough AC valves;
1 UX-210 type valve;
Wire, screws, etc.

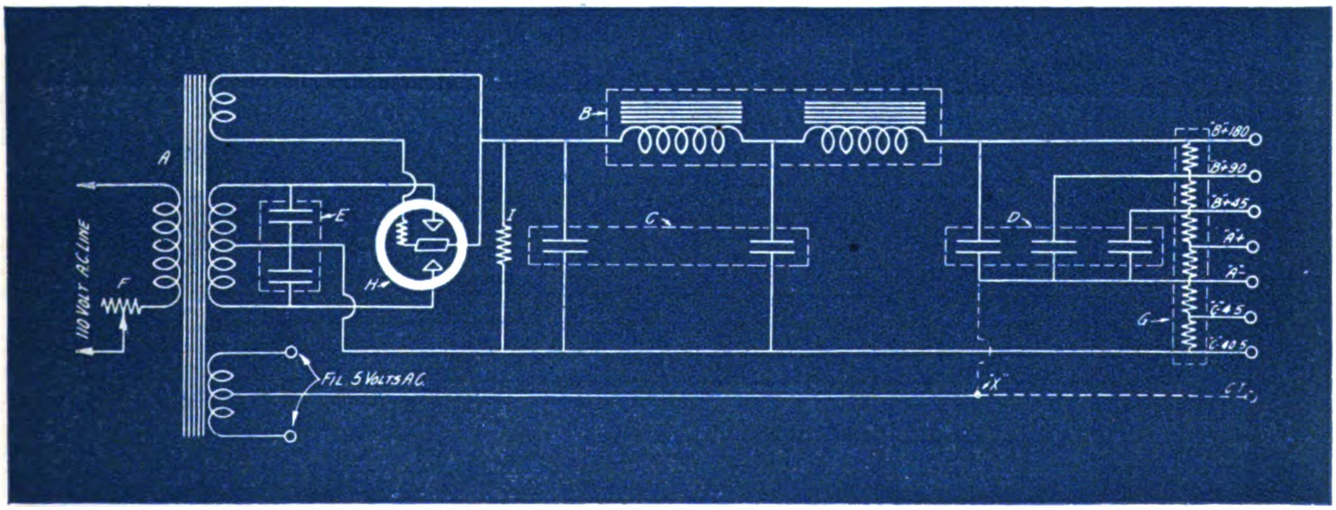
---

at all to get proper operation with increased volume and better quality than ever before.

Among other types of valves that may be used for this purpose is the new Raytheon high-current rectifier valve, and a special receiver incorporating this design will be described in the next issue of POPULAR RADIO.

We recommend that our readers who are experimentally inclined take this opportunity to experiment with these new hook-ups for AC valves and utilize the new forms of AC operation, so that they may keep ahead of the times and experience the benefits of these recent developments.

(Continued on page 158)



THE SCHEMATIC DIAGRAM OF THE Q. R. S. "ABC" POWER-PACK

FIGURE 7: *In this circuit a special transformer is used with a new high-power rectifier valve for supplying not only the "B" and "C" voltages, but the "A" power as well. This unit may be connected to any set in which the filaments of the standard valves employed have been wired in series.*

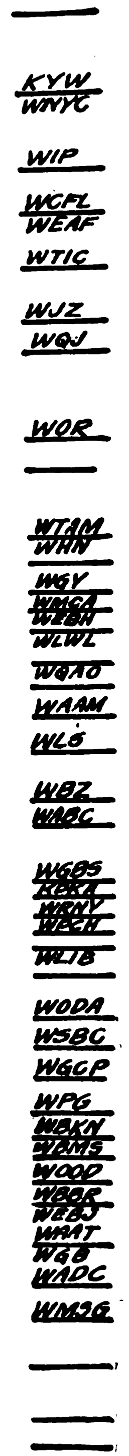
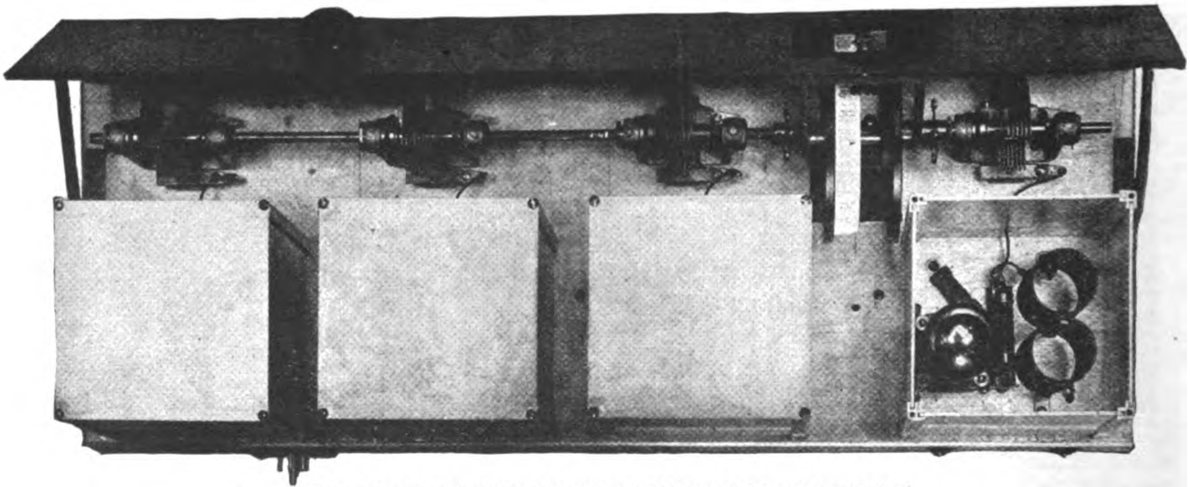


Figure 2: *A tuning calibration on the new set that was made at the time of the recent broadcast frequency changes.*

From a photograph made for Popular Radio

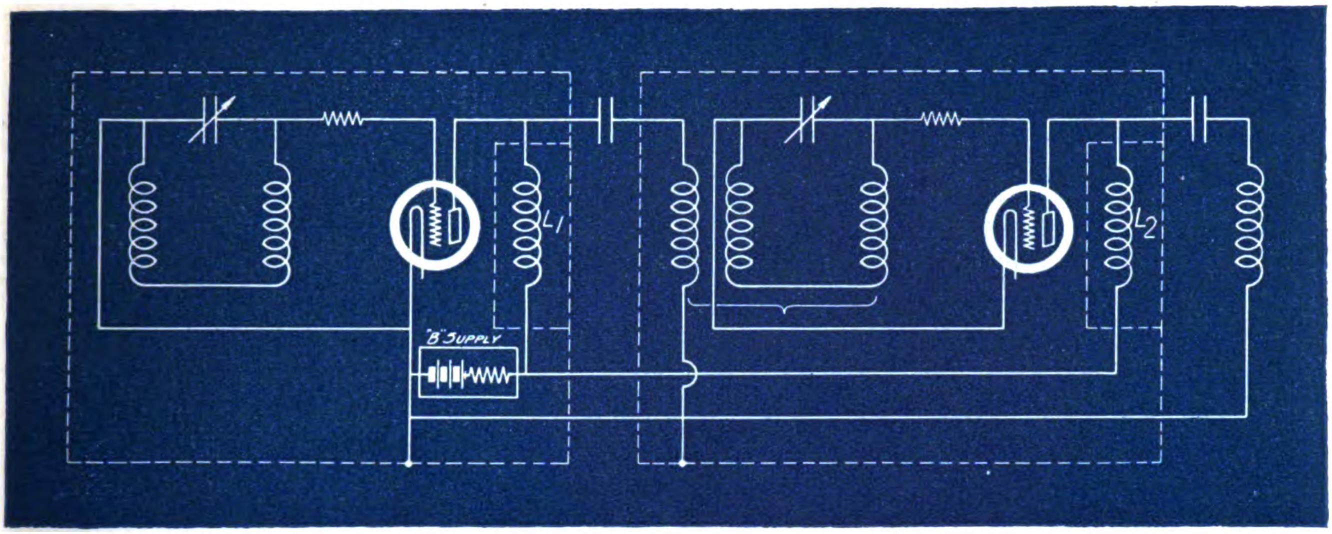
CHECKING UP ON THE OPERATING CHARACTERISTICS

Figure 1: *The various measurements outlined in this article were made on the early models of the LC-28 in the Popular Radio Laboratory; this series of researches brought to light many interesting facts that are important in high-frequency amplification.*



A TOP VIEW OF ONE OF THE MORE RECENT MODELS

Figure 3: *In this illustration is shown the layout of the metal chassis and the ganging arrangement of the four tuning condensers. The four shielded stages are also shown with the lid removed from the one at the extreme right. Notice the almost total absence of wiring.*



THE TYPE OF CIRCUIT USED IN THE NEW SET

FIGURE 4: *Here are shown two coupled high-frequency stages that are shielded and that are perfectly stable in operation, although the amplification obtained through the whole range of frequencies is of a remarkably high order.*

ADVANCE INFORMATION ABOUT THE NEW

LC-28 RECEIVER

Here are told some new and significant facts about efficient high-frequency amplification that were uncovered during the research work in the Popular Radio Laboratory on the new LC-28 Receiver. This information is of interest to engineers, experimenters and set builders alike.

By LAURENCE M. COCKADAY

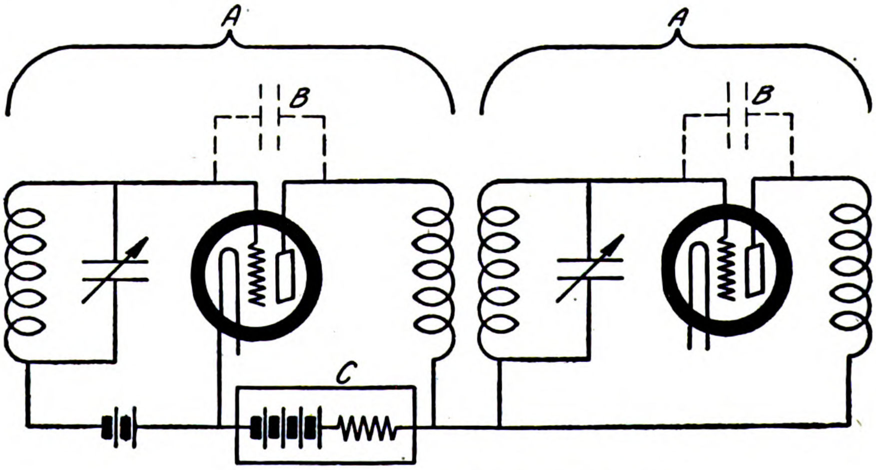
THE main thought back of the design of the LC-28 Receiver is a sound one, from both the engineering and economic standpoint.

To be most useful, a modern radio receiver should be a truthful reproducer of music and speech, and it should be capable of giving its owner not only selections at random, but specific selections that he wants to hear at particular times.

The modern radio receiver may be divided into the following five operating sections:

(A) The high-frequency pick-up;
(B) The phonograph pick-up;
(C) The low-frequency amplifier;
(D) The reproducer;
(E) The power apparatus.

The owner of a set outlined as above would use A, the high-frequency pick-up, to get his initial signals from the broadcasting stations. If he desired any particular selection at a certain time, he would use B, the phonograph pick-up. Both of these pick-ups should be capable of being switched to C, the low-frequency amplifier, that would amplify the electrical signals to the proper volume and pass them on to D, the reproducer, which should be either a high quality cone or an exponential type horn reproducer and which should re-



THREE MAIN CAUSES OF REGENERATION

FIGURE 5: *Coupling between the plate and grid coils that produce feed-back is shown at A. The capacitative coupling through an imaginery condenser formed by the capacity between the grid and plate is shown at B. The resistive-drop coupling in the "B" batteries is shown at C.*

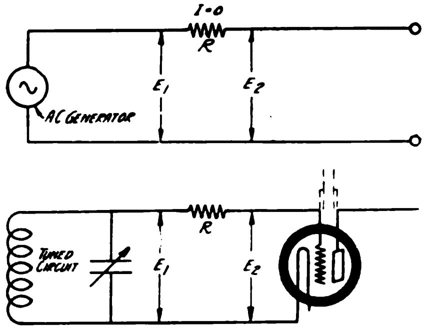


Figure 6: *The top diagram shows that there is no voltage drop in a resistor when no load flows through it. In other words, under this condition the output voltage E2 equals the input voltage E1. The bottom diagram shows this application to the grid circuit of a high-frequency amplifier. If the non-inductive, low-capacity resistance R is of a high enough value of resistance to prevent grid currents the grid voltage E2 will equal the initial voltage E1 without potential loss.*

produce the signals audibly and truthfully.

The power apparatus, E, is necessary to furnish the current for the filaments of the valves used, and the high voltage for the plate circuits of these valves.

Each one of these essential sections has a definite and separate function and the receiver can best be designed, built, and operated when their functions are separated and each unit is made to do its own work and nothing more.

In the old-time receiver, the set was built as a whole, and its separate functions were so interlocked that real efficiency was impossible.

Also, from the set-builder's standpoint, when formerly he had once built a set he could not take advantage of improvements in any particular section without discarding the whole set and building a new one. Obviously, this is a poor design, from an engineering point as well as an economical one.

This is the basic idea of the new LC-28: To give the set-builder a first-class high-frequency pick-up, consisting of three stages of high-frequency amplification that is stable, that gives the maximum in amplification, and that may be attached to a high-quality amplifier, any type of power-pack and a good reproducer. This system will allow the set-builder and the experimenter latitude in the choice of low-frequency amplifiers without changing the high-frequency end.

The Design of the LC-28 High-Frequency Pack.

The five main considerations taken into account in designing the LC-28 are the following:

1. Maximum amplification per stage;
2. Adequate stability throughout;
3. Adequate selectivity to meet all broadcast conditions;
4. Simple and easy tuning;
5. Smooth volume control from zero to maximum.

In order to get maximum amplification in a high-frequency circuit of the tuned-circuit variety utilizing vacuum valves, certain definite engineering laws must be satisfied. One of the greatest drawbacks encountered in obtaining a large amount of amplification in a single stage of high-frequency amplification is that unstable condition commonly called "oscillation," which usually interferes with and mars reception.

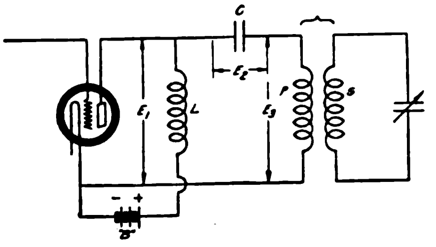
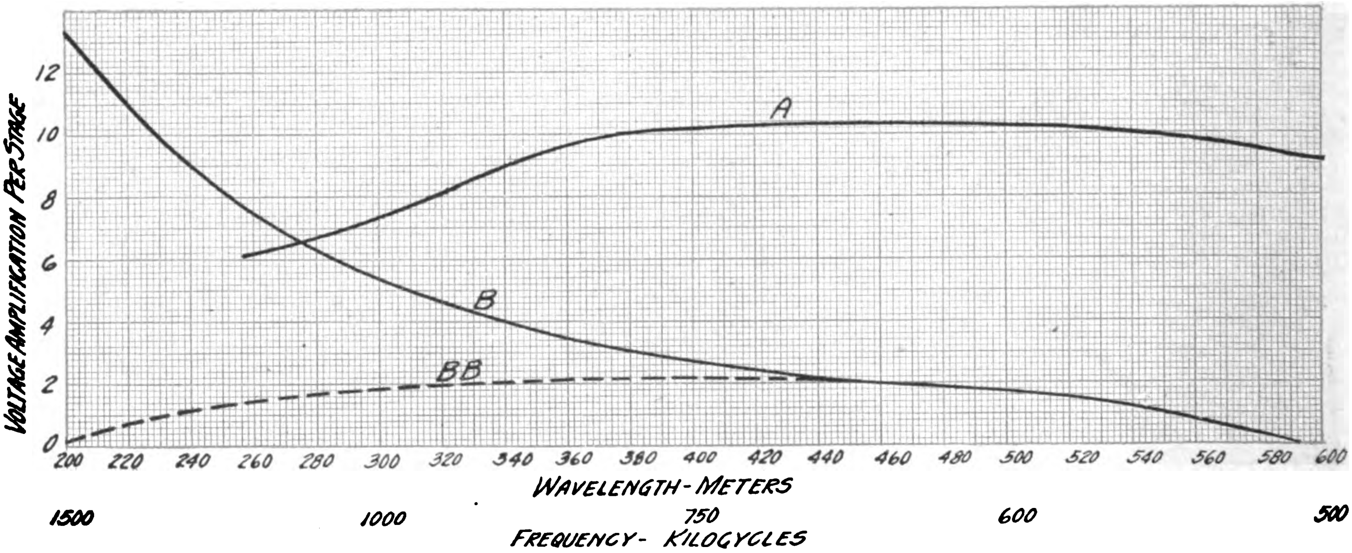


Figure 7: *The plate characteristics of a shunt-plate-feed amplifier circuit are best when the alternating-current voltage E3 across the primary coil P equals the alternating current voltage E1 induced in the valve from the preceding stage. This means that the voltage drop E2 across the coupling condenser C should be kept as low as possible for maximum efficiency.*

An unstable condition in a circuit is caused by the phenomena known as regeneration. This regeneration is usually present in a tuned-high-frequency circuit, due to one or more of the three causes illustrated in Figure 5. In this schematic drawing are shown two stages of high-frequency amplification tuned with variable condensers connected in the grid circuit and shunted across the secondary coils. The coupling between the coil in the grid circuit and the coil in the plate circuit, in both stages, is shown at *A*. This coupling is one of the main causes of regeneration and inherent unstability. It is caused by electromagnetic feed-back from the plate coil to the grid coil.

The second important cause is due to the inter-electrode capacity between the elements of the vacuum valve itself; this is shown in dotted lines at *B* in Figure 5. Regeneration is introduced into the circuit by the feed-back of energy through the small condensers formed by the grid and plate.

(*Continued on page 178*)



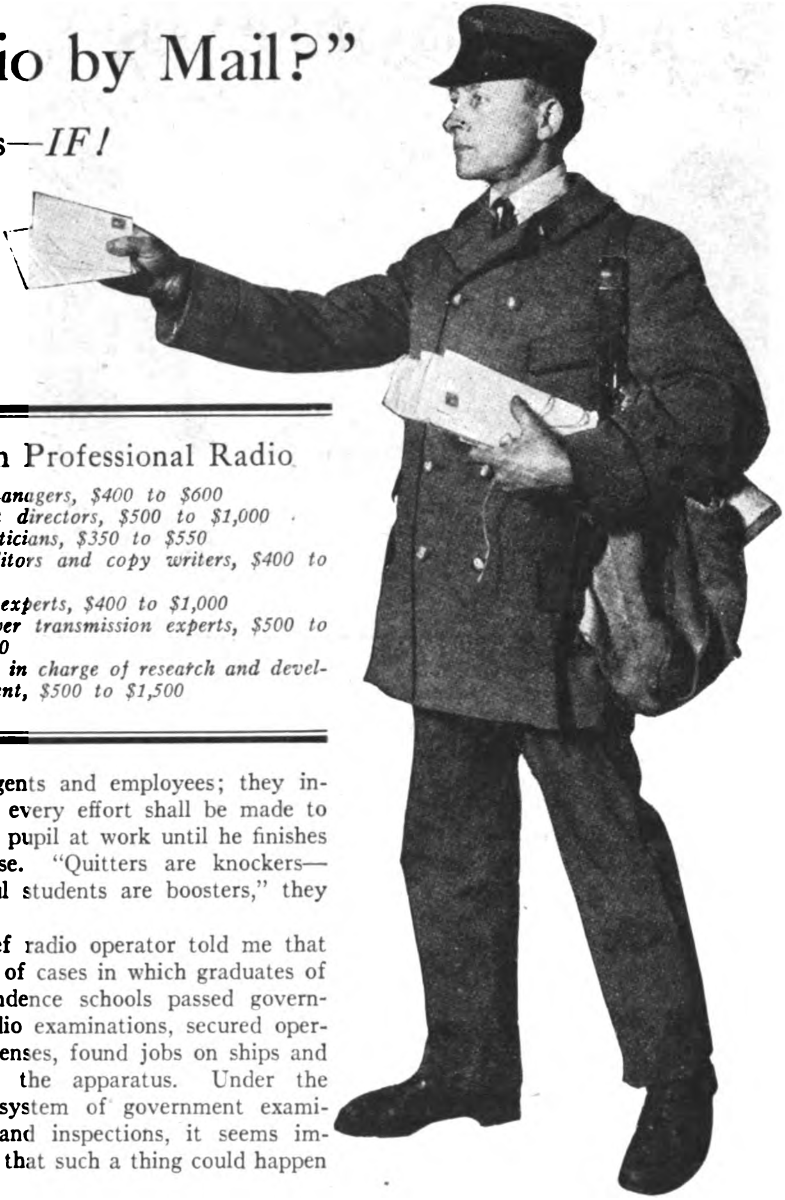
AMPLIFICATION CURVES THAT TELL A STORY

Figure 8: *The curve A shows the high amplification obtained with a new LC-28 Receiver. The curve B, shown for comparison, is of a standard high-frequency circuit. The quick rise in B at high-frequencies (low wavelengths) is harmful and is due to regeneration. If there were no regeneration in the set from which curve B was made, it would have a curve similar to that shown at BB.*

"Can I Learn Radio by Mail?"

The answer is yes—*IF!*

By ARMSTRONG PERRY



How the Monthly Salaries Range in Professional Radio

Radio telegraph operators, $100 to $200
Broadcast operators, $200 to $350
Broadcast announcers, $200 to $300
Trained mechanicians, $100 to $200
Radio inspectors, $200 to $400
Commercial engineers, $250 to $350
Designers of mechanical apparatus, $400 to $600
Acoustical experts, $350 to $650
Studio managers, $400 to $600
Broadcast directors, $500 to $1,000
Mathematicians, $350 to $550
Radio editors and copy writers, $400 to $800
Receiver experts, $400 to $1,000
High-power transmission experts, $500 to $1,000
Physicists in charge of research and development, $500 to $1,500

FOR the last five years one college after another has been offering correspondence courses in radio. This has led some persons to wonder if the colleges are looking for some of the "easy money" that the correspondence schools were said to be making, or whether the learn-by-mail system has been good in spite of the criticisms that once were made concerning it.

The business executive who employs radio men seems to care little how or where they got their education; all he wants to know is that they can handle the jobs he wants them to fill. If a man who wants a radio job can get the education he needs from a correspondence course, he may save time and expense.

Some correspondence schools that offer radio courses have been accused of attracting pupils by advertising results that most students never will attain. I believe that the possibilities suggested in correspondence school advertising are within the reach of the average man—provided that he completes the course and takes the next step. If he quits, no school can help him.

I have heard critics say that some of the radio correspondence schools try to discourage their pupils by giving them too much work and by writing disagreeable letters after they have collected the fees. If this were true, it would show a lack of common sense at least. There is no reason for a pupil permitting himself to be bluffed off. He cannot be compelled to proceed any faster than he wishes. I have seen the instructions given by a large correspondence school to its agents and employees; they insist that every effort shall be made to keep the pupil at work until he finishes his course. "Quitters are knockers—successful students are boosters," they say.

A chief radio operator told me that he knew of cases in which graduates of correspondence schools passed government radio examinations, secured operators' licenses, found jobs on ships and damaged the apparatus. Under the present system of government examinations and inspections, it seems improbable that such a thing could happen often.

Obviously, the only way to become thoroughly familiar with radio apparatus is to work with it. Correspondence schools improve their standing when they provide for and require practical experience as well as the study of theory. Some of them have residence schools where correspondence pupils get such experience before they receive their certificates. In any case, it is entirely possible for a student, even if his time and cash are limited, to construct and operate apparatus at home.

It has also been charged that correspondence schools sometimes collect for a complete set of books or for a complete course of instruction, knowing that the pupil will never complete the course unless he is exceptional. But real estate dealers, grocers and furniture stores have a similar habit. The real estate man collects the payments on my house whether I occupy it or not; the grocer presents his bill without asking whether I have eaten the things purchased; the furniture has to paid for whether I use it or not. It costs money to prepare and conduct correspondence courses. Even if 99 men out of a 100 go no further than the tenth lesson, it is necessary to have a complete course ready for the hundredth man. For legal purposes the school must be able to show that it can deliver the entire course.

The correspondence method of instruction has proven its value in ancient Rome, in Europe for two centuries, in the Chautauqua Literary and Scientific Circle that has enrolled thousands in the past half century, and in modern correspondence schools, one of which has enrolled over 2,000,000 pupils. The thousands of radio amateurs who have educated themselves in radio theory and practice by reading books and POPULAR

(*Continued on page* 188)

★ PROGRAM FEATURES *for* THE MONTH

Here is Popular Radio's *selection of the "star" broadcast features that are scheduled as regular weekly events for the month beginning August 22—program numbers of outstanding merit that are selected on the basis of intrinsic worth, as well as upon their importance as determined by the large audiences reached by powerful single stations and by the chain stations that now cover the country. Every radio fan has—or should have—a receiver good enough to tune in on most of the features that are listed.*

(THE PROGRAMS GIVEN HERE ARE SCHEDULED ACCORDING TO EASTERN DAYLIGHT SAVING TIME; FOR BROADCAST LISTENERS LIVING IN LOCALITIES THAT USE EASTERN STANDARD TIME, THE TIMES OF PERFORMANCE ARE AN HOUR EARLIER THAN EASTERN DAYLIGHT SAVING TIME.)

Mondays

Roxy and His Gang; 7.30 p. m.; *110-piece symphony orchestra, with soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WRC, WSB, WHAS, WSM, WBAL, WJR, WOC, WCCO, WHAM.

The musical masterpiece of each week and perhaps the greatest extravaganza on the air. This hour and a half is filled with music of a 110-piece orchestra, special studio symphony and scores of vocalists and instrumentalists. It is the essence of variety, charm and entertainment. Roxy also has plenty of surprises each week.

Schwarz Homemakers; 9.00 p. m.; *variety;* WABC.

Although this is a new WABC feature, it has been remarkably successful. There seems to be no set form of entertainment. It is usually made up of orchestral, vocal and instrumental music, well sung and well played.

WBAL Ensemble; 9.00 p. m.; *chamber music;* WBAL.

The Staff of WBAL, Baltimore's first radio station, has in the past made a specialty of chamber music; and perhaps there is no better source in the country. This particular event is one to which the editor of this column always tunes.

Spotlight Hour; 9.00 p. m.; *orchestra and features;* WJZ, KDKA.

Lido Venice Dance Orchestra; 10.10 p. m.; *jazz music;* WEEI.

The dance orchestra of the Lido Venice is New England's pride and all the youngsters of the great bean and pie country are ardent followers of this particular event.

WBAL Dance Orchestra; 11.00 p. m.; *dance music;* WBAL.

Late evening dancers do not need to search long for snappy one-steps if they are within easy reach of WBAL's well-modulated waves.

Coronada Orchestra; 1.00 a. m.; *dance music;* KMOX.

KMOX and the Coronada Dance Orchestra burn midnight tubes to supply the Middle West with a gold label brand of dance music.

Tuesdays

Dinner Concert; 6.30 p. m.; *classical and semi-classical music;* WGY.

If it were not for WGY and its dinner concerts from Hotel Ten Eyck many people in New York State and the western fringes of New England would have to eat musicless meals.

George Olsen's Stromberg-Carlson Orchestra; 8.00 p. m.; *dance music;* WJZ, WBZ, KDKA, KYW, WBZA, WJR, WHAM.

George Olsen helping to sell radio receivers by giving samples of real radio music. George Olsen is one of the great captains of the jazz industry and it is said that he is as serious with his jazz as Wagner was with his operas—which is pretty serious.

Edison Ensemble; 8.00 p. m.; *classic and popular music;* WRNY.

A neat little ensemble supplying a good-will program for the New York Edison Company. The New York Edison Ensemble is said to amount to about half of WRNY's reputation, which is not far from true.

Grand Opera Program; 9.00 p. m.; *soloists and instrumentalists;* WJZ, KDKA, KYW.

The National Broadcasting shows how excerpts of the most popular operas should be handled on the air. These programs have been particularly well chosen and only the most popular music from each opera is selected for reproduction.

Eveready Hour; 9.00 p. m.; *varied program;* WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAM, WGN, WSAI, WRC, WGY, WHAS, WSM, WSB, WMC, WDAF.

The Eveready program is ever good, ever entertaining and never trite. Although it runs on a light summer schedule, big things begin to happen at the end of September.

Educational Program; 9.00 p. m.; *lectures;* WLWL.

WLWL becomes a little high-brow with important lectures about this and that, but always about things that normal people are interested in.

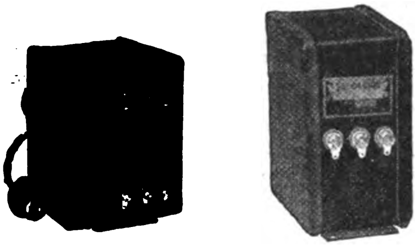
Mixed Quartet; 9.00 p. m.; *popular ballads;* WBAL.

Although the editor is not particularly fond of quartets, he does listen to this one occasionally. This is not necessarily an endorsement, but the quartet fan will not make a great mistake by following his example.

Sam 'n' Henry; 9.00 p. m.; *negro comedy;* WGN.

Negro comedy hot from the griddle and dished up by a couple of old-timers who probably have more laughs to their credit than any other team on the air. Since the Record Boys have left the air, Sam 'n' Henry reign supreme as the great masters of nigger comedy and psychology.

New!



THORDARSON
POWER TRANSFORMERS

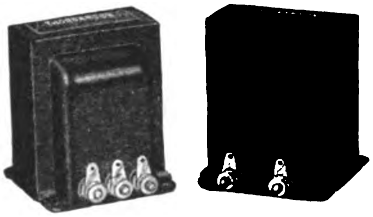
130 M. A. FULL WAVE RECTIFIER

Here is a power unit that will satisfy the ever increasing demand for improved quality of reception. A split secondary 550 volts either side of center, makes possible full wave rectification, using two 216-B or two 281 tubes. Current capacity, 130 milliamperes. The low voltage secondary, 7½ volts, will supply two UX-210 power tubes, enabling the use of push-pull amplification in last audio stage.

The Double Choke Unit 2099 is designed for this power unit. Contains two individual chokes of 30 henries, 130 milli-amperes capacity each.

T-2098 Transformer, 4½"x 5¼"x 5¾"
List Price, $20.00

T-2099, Choke Unit
3¼"x 4⅞"x 5⅝" high
List Price
$14.00



POWER PUSH-PULL TRANSFORMER and CHOKE

Quality reproduction that cannot be obtained with straight audio amplification, is made possible through the Thordarson power push-pull combination. This arrangement is designed for use with power tubes only and has sufficient capacity for all tubes up to and including the UX-210. Makes an ideal power amplifier when used with power supply unit T-2098.

Input transformer couples stage of straight audio to stage of push-pull. Output choke is center-tapped with 30 henries on either side of center tap. Dimensions of both transformer and choke, 2½" x 2½" x 3" high.

Input Transformer T-2408
List Price, $8.00

Output Choke T-2420
List Price
$8.00

A. C. TUBE FILAMENT SUPPLY

The new R. C. A. and Cunningham A. C. filament tubes will be very popular with the home constructor this season. The Thordarson Transformer T-2445 is designed especially for these tubes. Three separate filament windings are provided.

Sec. No. 1, 1½ volts, will supply six UX-226 amplifier tubes.

Sec. No. 2, 2½ volts, will supply two UX-227 detector tubes.

Sec. No. 3, 5 volts, will supply two 5 volt power tubes.

In addition to the above, this transformer is equipped with a receptacle for the B-supply input plug. Supplied with six-foot cord and separable plug for attachment to the light circuit. Transformer in compound filled, crackle-finished case. Dimensions — 2¾"x 5¾"x 4¾".

A. C. Tube Supply, T-2445
List Price, $10.00

Realistic tone quality, that elusive but much talked of characteristic of radio reception— can be obtained only through the use of apparatus of the finest materials and workmanship. For years Thordarson transformers have been the choice of many discriminating manufacturers of quality receiving sets. Follow the lead of the leaders. If you enjoy good music *specify Thordarson transformers*

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

THORDARSON ELECTRIC MFG. CO.
500 W. Huron St., Chicago, Ill.
Gentlemen:
Please send me your booklets describing your new power supply transformers.

*Name*________________

*Address*________________

*City*____________ *State*______

(3562C)

Wednesdays

Benjamin Franklin Orchestra; 6.15 P. M.; *popular music;* WIP and WGBS.

The Benjamin Franklin Orchestra is a Philadelphia musical institution of considerable importance, and now that WIP has joined WGBS in a little chain New York fans are coming to appreciate this good music from the Quaker City.

Dinner Concert; 6.45 P. M.; *chamber music;* WSM.

At 6.15 P. M. sharp on Wednesday WSM unobtrusively comes to the air with a little dining-room ensemble whose director is particularly clever in arranging his musical menu. This is a musical event that should be appreciated by everybody that likes chamber music.

Radio Nature League; 7.30 P. M.; *nature talks;* WBZ.

Thornton Burgess with his nature league has been tremendously successful in awakening an interest in natural science. His lectures are filled with interesting observations and oftentimes he calls upon professors of entomology, botany, ichthyology and many other "ologies" to help him make natural science a popular subject with people of all ages. Mr. Burgess broadcasts direct from the studio of Hotel Kimball, where he lives.

Katz and His Kittens; 8.00 P. M.; *dance orchestra;* WQJ.

Katz and His Kittens seem to be Chicago's idea of a pretty smart dance orchestra. We are inclined to share this opinion and believe that anyone dancing to this half-hour of rousing dance music makes just about the same decision.

Steindal String Quartet; 8.30 P. M.; *semi-classical music;* KMOX.

The Spirit of St. Louis taking the form of a good program of classical numbers.

Remington Typewriter Band; 8.30 P. M.; *typical band selections;* WGY.

The Remington Typewriter Company entertains the citizens of Ilion, N. Y., each Wednesday night at 8.30 P. M. with a band made up of Remington employees. The music from this band, which is under the direction of W. L. Daniels, is so good that the scouts of WGY discovered it and put it on the air.

Ipana Troubadours; 9.00 P. M.; *dance music;* WEAF, WEEI, WGR, WRC, WCAE, WWJ, WLIB, KSD, WCCO, WGY.

The Ipana Troubadours are full of bombastic music that would do anything but remind one of the fact that his supply of toothpaste is low. As long as advertisers use such agreeable means for popularizing their products, the editor of this department should be very happy to listen to them.

Maxwell Hour; 9.00 P. M.; *orchestra and soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WHAS, WSB, WMC, WSM, WJAX, WBAL, WJR.

The Maxwell Coffee Hour is an hour that needs no endorsement by this publication. The fact that Nathaniel Schilkret is its director is an endorsement of sufficient value for fans who know music. Perhaps no other single feature is followed so closely or more keenly by the music lovers of airdom.

Goodrich Silver Masked Tenor and Orchestra; 10.00 P. M.; *popular music;* WEAF, WEEI, WCCO, WGN, WCAE, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WSAI, WCSH, WADC, WHAS, WSB, WSM, WMC.

Joseph Knecht and the Silver Masked Tenor return to the air supported by the famous Goodrich Orchestra. Both Mr. Knecht and the Silver Masked Tenor come to WEAF after finishing a vaudeville tour that took them over the major part of the United States of America.

Sunset Instrumental Quartet; 10.00 P. M.; *popular numbers;* KFI.

Ray Fisher is "big guns" on the Coast and all of the people of California know it.

National Light Opera Company; 10.10 P. M.; *tabloid versions of well-known light operas;* WEAF, WEEI, WLIT, WRC, WCAE, WGY, WGR, KSD, WMAQ.

Carefully edited vest-pocket editions of light operas supplied by the National Broadcasting Company and a chain of associated stations.

Waldorf Orchestra; 10.30 P. M.; *dance music;* WABC.

Harold Leonard gives the late listeners of WABC a good time with a lot of good tunes. This music brings back to memory the good old days when Joseph Knecht used to direct the snappy Waldorf Orchestra.

Herlihey's Dance Orchestra; 11.00 P. M.; *dance program;* WOR.

Joe Herlihey takes the place of Hogan's Dance Orchestra with great success. WOR has always been rather fussy about its dance music and it usually manages to broadcast only the best.

Bamboo Garden Orchestra; 11.00 P. M.; *dance music;* WTAM.

WTAM trying to establish itself in the field of jazz. Although this music would not pass muster in New York, it sounds pretty good for Cleveland.

Thursdays

WBAL Dinner Music; 6.30 P. M.; *classical and semi-classical selections;* WBAL.

Sunset music supplied by the WBAL ensemble. This is a period of old-fashioned music that you enjoy, providing you are not erratic.

Concert Music; 7.35 P. M.; *classical selections;* WGN.

The capital of jazz steps out with a little contribution of chamber music. It is said that there are more jazz bands in Chicago per square mile than any other place on earth. How strange this chamber music must sound to Chicago listeners!

RCA Radiotrons; 8.00 P. M.; *songs and comedy;* WJZ, WBZ, KDKA, WEBH, WBZA.

The R. C. A. popularizing its Radiotrons with a varied act of no small consequence. There is no set style to this program, as its originators have allowed this latitude for plenty of variety.

Clicquot Club Eskimos; 9.00 P. M.; *banjo ensemble;* WEAF, WEEI, WCCO, WGN, WGY, WJAR, WTAG, KSD, WOC, WGR, WFI, WWJ, WRC, WCSH, WDAF.

Who can say that the Eskimos are not among the radio immortals and who can say that the Eskimos have not supplied as many watts of invigorating radio music as any other radio performance on the air?

Fuller Orchestra; 9.30 P. M.; *popular music;* WGHP.

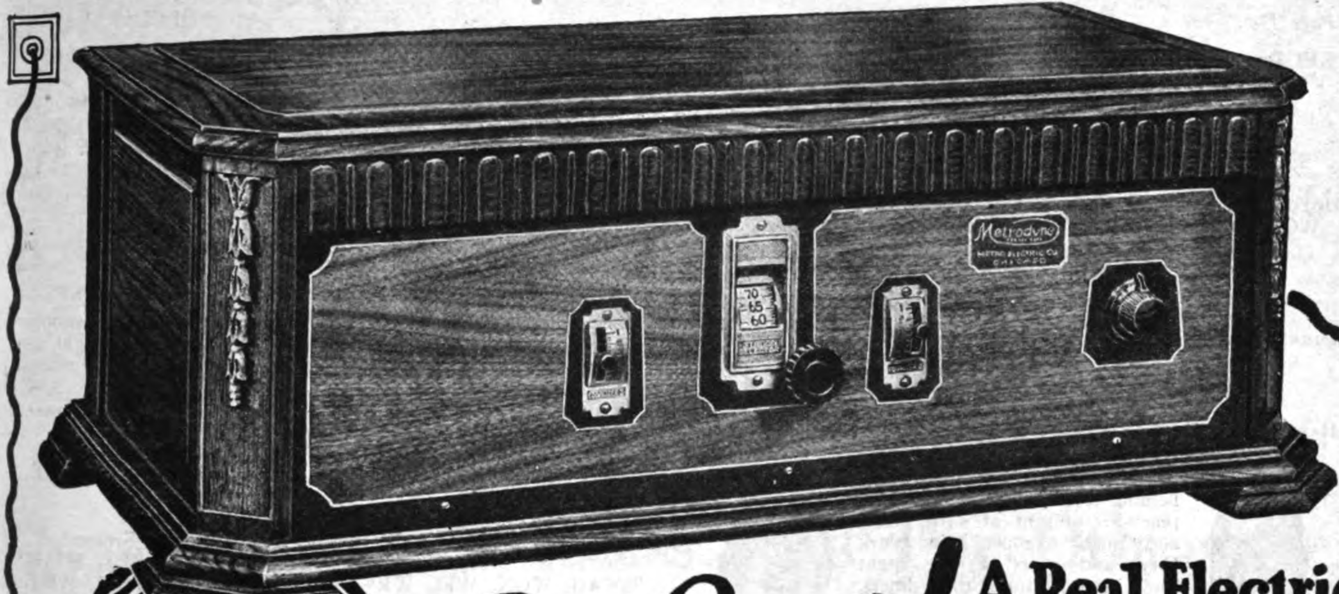
Any jazz band that can win in a competition with the other million jazz bands in the Chicago district must be good enough to win editorial support in Popular Radio.

David Lawrence; 10.00 P. M.; *"Our Government," lecture;* WEAF, WGR, WRC, KSD, WGY, WMAQ, WEEI, WTAG.

David Lawrence talks a lot about the United States Government telling him things that over a million people know absolutely nothing about. He is well able to make civic government and political economy a popular subject.

Hotel Bossert Orchestra; 11.00 P. M.; *popular dance orchestra;* WEAF, WGY.

Here's a refreshing hour of music from the Marine Room of Hotel Bossert in Brooklyn, N. Y. This is one of the most listened-to summer programs of WEAF. It is said that one can feel the harbor breezes come out of the loudspeaker—which is, perhaps, rank exaggeration.



Now! A Real Electric Radio Set

Three Year Guarantee

Shipped direct from our factory at rock bottom prices—cost less than most battery sets

No Batteries, Chargers or Eliminators

No Acids; No Liquids—Plug In—Press Button—"Tune In'

Metrodyne

ALL ELECTRIC RADIO

30 Days Free Trial

AGENTS! DEALERS! BIG PROFITS!

Make big money taking orders for Metrodynes. All or part time. Metrodyne All Electric Radios are in a class by themselves. Unequalled for quality, performance and price. Demonstrate at home and take orders. Lowest wholesale prices. Your demonstrating set on 30 days' free trial. Mail coupon below for details.

7 Tubes—Single Dial Set

100% Electric Radio

At last! The radio you've dreamed about! If you have electricity in your home you can now really enjoy **coast to coast** radio reception without the care, bother and muss of batteries, chargers, eliminators, etc. The Metrodyne All Electric is a real, genuine **batteryless** radio set. Simply insert the plug in the socket, press the switch button and "tune in." You could not possibly buy a better radio set than the Metrodyne All Electric, no matter what price you paid.

BEAUTY—EFFICIENCY DEPENDABILITY

The Metrodyne All Electric Radio is a 7 tube, single dial set. Only the highest quality low loss parts are used throughout. Solid walnut cabinet, beautiful two-tone effect, with handsome gilt metal trimmings. Size of cabinet, 28 inches long, 13 inches deep, 10 inches high. Has electrically lighted dial so that you can log stations in the dark. Only one dial to tune in all stations. Excellent tone qualities — wonderful volume — very selective.

Costs Less Than Most Battery Sets

Do not confuse the Metrodyne electric radio with ordinary light socket sets, because the Metrodyne is truly an **all electric radio** — consumes less than 2c worth of power a day. Comes to you **direct from the factory.** Its low cost brings it down to the price of an ordinary battery set. We are so confident that you will be delighted with this wonderful, easy-to-operate **batteryless radio** that we offer to ship it to your home for **thirty days' free trial** — you to be the judge.

Gorgeous Console Electric Radio

Here is the Metrodyne All Electric Console Radio — a gorgeous, genuine walnut cabinet, in a beautiful two-tone finish. Has a built-in genuine Metro-Cone large size speaker. Brings in programs with great volume, reproducing the entire range from the lowest to the highest notes with remarkable clearness and distinction. All metal parts are finished in old gold. Wonderful electric radio, in a cabinet that will beautify the appearance of any home.

Mail This Coupon

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer,** which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis — **WRITE TODAY!**

METRO ELECTRIC COMPANY

2165 N. California Ave. *Dept. 611* Chicago, Illinois

METRO ELECTRIC COMPANY
2165 N. California Ave., Dept. 611
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne All Electric Radio and your **thirtydays' free trial offer.**

Name

Address

If you are interested in AGENT'S proposition place an "X" in the square → ☐

MAIL COUPON NOW!

KFI Drama Hour; 11.00 P. M.; *varied program;* KFI.

Booming drama supplied by the station that has a reputation for being rather flighty.

Fridays

Hotel Bretton Hall Orchestra; 6.30 P. M.; *chamber music;* WOR.

Hotel Bretton Hall's orchestra has been replaced by that of the Sheldon, and WOR can be justly proud of its choice in either case.

Dinner Orchestra; 6.30 P. M.; *popular selections;* WBAL.

WBAL with another one of its popular dinner concerts, supplied by its own musical organization.

Happiness Boys; 7.30 P. M. (beginning in September); *songs and jokes;* WEAF.

The Happiness Boys are now helping to put over a new Happiness restaurant at 44th Street and Fifth Avenue, New York City, and every Friday night they sing before the diners. WEAF picks the event up by remote control and broadcasts it just for old time's sake.

Hotel Whitehall Trio; 7.45 P. M.; *string trio playing classics and semi-classics;* WABC.

Hotel Whitehall Trio supplies a little program of choice classical and semi-classical music for the listeners of WABC. This trio is more than the average hotel trio.

Chelsea Concert Orchestra; 8.00 P. M.; *chamber music;* WPG.

A Great Atlantic City boardwalk hotel permits listeners of the United States to sample its dinner music.

Royal Hour; 8.30 P. M.; *orchestra and soloists;* WJZ, WBZ, WBZA, KDKA, KYW, WBAL, WJR.

The Royal Typewriter Company out for customers with a half-hour of music that has set up new standards.

Philco Hour; 9.00 P. M.; *vocal and orchestral;* WJZ, WBZ, WBZA, KDKA, KYW.

Another radio manufacturer trying to pay its debt to broadcasting.

La France Orchestra; 9.30 P. M.; *popular orchestral music;* WEAF, WGR, WLIT, WOC, WCAE, WTAM, WWJ, KSD, WDAF, WMAQ, KSD.

Anna Byrne still at it with her very, very, very popular orchestra.

Dance Orchestra; 11.00 P. M.; *dance music;* KDKA.

Real good dance music emerging from the smoke of Pittsburgh.

Saturdays

Jacques Renard's Orchestra; 6.45 P. M.; *dance music;* WEEI.

One of two particularly good dance orchestras broadcasting from the Bean City.

Mediterranean Dance Orchestra; 8.30 P. M.; *dance selections;* WJZ.

Hotel Traymore Concert; 9.00 P. M.; WPG.

An Atlantic City hotel supplying the public with a lot of good concert music.

Benjamin Franklin Orchestra; 10.05 P. M.; *chamber music;* WIP.

Benjamin Franklin Orchestra has been one of the favorites of the editor of this column for a long time and he can recommend it with a feeling that he cannot be taken as an easy musical customer.

Colorado Orchestra; 12.30 A. M.; *dance music;* KOA.

KOA stirs the midnight air with a big dance band.

KFI Midnight Frolic; 3.00 A. M.; *musical jamboree;* KFI.

KFI breaks loose with an after-theater show of pretentious proportions. This air entertainment takes the form of an air vaudeville show, with many actual vaudeville entertainers involved.

Sundays

Roxy Stroll; 2 P. M.; WJZ, KDKA, KYW, WRC, WOC, WJR, WBZ, WBZA.

Crosley Radio Feature (beginning third week in September); 5.30 P. M.; *Moscow Art Orchestra;* WEAF, WEEI, WJAR, WTAG, WGN, WFI, WRC, WCSH, WCAE, WTAM, WWJ, WSAI, KSD, WDAF, WHAS, WSM, WSB, WMC, WGY.

The Crosley Radio Hour with the Moscow Art Orchestra calls for applauding with elevated hands and shouts of "Bravo."

Estey Organ Recital; 7.00 P. M.; *organ and vocal;* WJZ, WBAL.

The old WJZ stand-by, with Park Hogan, the official Estey organ concert-master, at the console.

The Capitol Grand Orchestra (and Major Bowes' family); 7.20 P. M.; *symphonic music and soloists;* WEAF, WEEI, KSD, WRC, WWJ, WJAR, WCAE, WTAG, WHAS, WSB, WSM, WMC.

The big Sunday feature, with a 100-piece symphony and all kinds of vocal and instrumental talent turned loose. Major Bowes is Master of Ceremonies. Among Major Bowes' outstanding artists is Wee Willy Robyn, often called the "little man with the big voice."

Hotel Shelton Concert; 7.45 P. M.; *chamber music and solos;* WOR.

Here is a restful hour of music well fitted to a Sunday afternoon mood.

Cook's Tours; 8.00 P. M.; *travelogue with music;* WJZ.

Here's an opportunity to learn something about the other half of the world and how it likes its music.

Ambassador Concert; 9.10 P. M.; *chamber music;* WPG.

WPG must have a hard time trying to find room for all the Atlantic City hotel orchestras on its program.

Atwater Kent Hour; 9.15 P. M.; *star soloists;* WEAF, WEEI, WFI, WCCO, WTAM, WGN, WCAE, WGR, WOC, WTAG, WWJ, KSD, WRC, WSAI, WGY, WHAS, WSB, WMC.

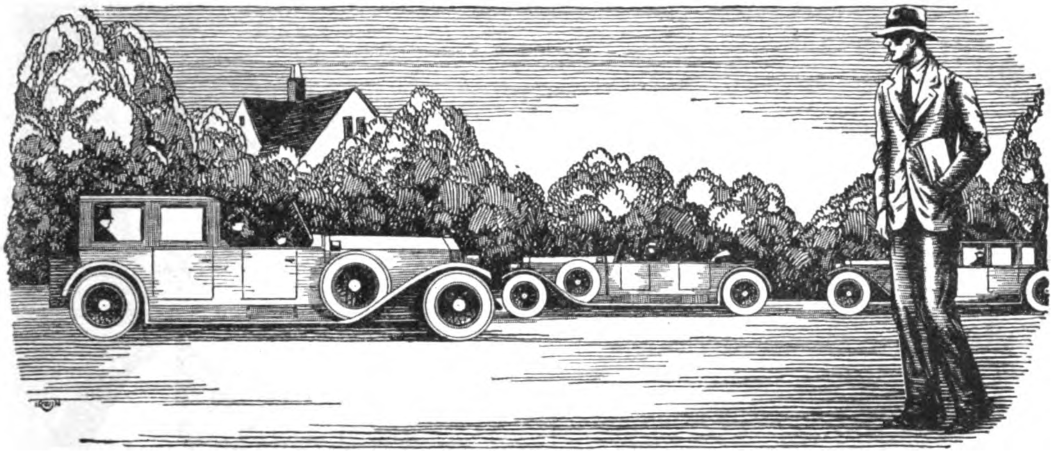
Although the Atwater Kent Hour is not as good in the summertime as in the wintertime, it is good enough in the summertime to listen to regularly. The conductor is Niccoli Berezowski.

WABC Hour of Dance Music; 11.00 P. M.; *popular dance music;* WABC.

WABC deals in nothing but high-grade dance music.

A Transmitter for Less Than $30

A short-wave transmitting set that has a range of two thousand miles or more and that can operate on ordinary receiving set valves and batteries may be built for less than thirty dollars. Buy the October number of POPULAR RADIO and get the full constructional details.



Many times in the old days, while I trudged home after work to save carfare, I used to gaze enviously at the shining cars gliding by me, the prosperous men and women within. Little did I think that inside of a year, I, too, should have my own car, a decent bank account, the good things of life that make it worth living.

I Thought Success Was For Others

Believe It Or Not, Just Twelve Months Ago I Was Next Thing To "Down-and-Out"

TODAY I'm sole owner of the fastest-growing Radio store in town. And I'm on good terms with my banker, too—not like the old days only a year ago, when often I didn't have one dollar to knock against another in my pocket. My wife and I live in the snuggest little home you ever saw, right in one of the best neighborhoods. And to think that a year ago I used to dodge the landlady when she came to collect the rent for the little bedroom I called "home"!

It all seems like a dream now, as I look back over the past twelve short months, and think how discouraged I was then, at the "end of a blind alley." I thought I never had had a good chance in my life, and I thought I never would have one. But it was waking up that I needed, and here's the story of how I got it.

I WAS a clerk, working at the usual miserable salary such jobs pay. Somehow I'd never found any way to get into a line where I could make good money.

Other fellows seemed to find opportunities. But—much as I wanted the good things that go with success and a decent income—all the really well-paid vacancies I ever heard of seemed to be out of my line, to call for some kind of knowledge I didn't have.

And I wanted to get married. A fine situation, wasn't it? Mary would have agreed to try it—but it wouldn't have been fair to her.

Mary had told me, "You can't get ahead where you are. Why don't you get into another line of work, somewhere that you can advance?"

"That's fine, Mary," I replied, "but *what* line? I've always got my eyes open for a better job, but I never seem to hear of a really good job that I can handle." Mary didn't seem to be satisfied with the answer but I didn't know what else to tell her.

It was on the way home that night that I stopped off in the neighborhood drug store, where I overheard a scrap of conversation about myself.. A few burning words that were the cause of the turning point in my life!

With a hot flush of shame I turned and left the store, and walked rapidly home. So that was what my neighbors—the people who knew me best—really thought of me!

"Bargain counter sheik—look how that suit fits," one fellow had said in a low voice. "Bet he hasn't got a dollar in those pockets." "Oh, it's just 'Useless' Anderson," said another. "He's got a wish-bone where his back-bone ought to be."

As I thought over the words in deep humiliation, a sudden thought made me catch my breath. Why had Mary been so dissatisfied with my answer that "I hadn't had a chance"? *Did Mary secretly think that too?* And after all, wasn't it *true* that I had a "wish-bone" where my back-bone ought to be? Wasn't that why I never had a "chance" to get ahead? It was true, only too true—and it had taken this cruel blow to my self-esteem to make me see it.

With a new determination I thumbed the pages of a magazine on the table, searching for an advertisement that I'd seen many times but passed up without thinking, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully, and when I finished it I made my decision.

WHAT'S happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, *I've had a Radio business of my own!* At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

NOW I'm making real money. I drive a good-looking car of my own. Mary and I don't own the house in full yet, but I've made a substantial down payment, and I'm not straining myself any to meet the installments.

Here's a real tip. You may not be as bad off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you'd better be *doing* something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well-paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. K-86, Washington, D. C.

J. E. SMITH, President,
National Radio Institute,
Dept. K-86, Washington, D. C.

Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesmen will call on me.

Name..

Address.......................................

Town..........................State............

ACME

Flexible Celatsite Wire

A cable of fine, tinned copper wires with non-inflammable Celatsite insulation. Ideal for sub-panel or point-to-point wiring. Strips easily, solders readily. Nine beautiful colors; *sold only in 25 ft. coils, in cartons colored to match contents.*

Acme Celatsite Wire

Tinned copper bus bar hook-up wire with non-inflammable Celatsite insulation, in 9 beautiful colors. Strips easily, solders readily, won't crack at bends. Sizes 14, 16, 18, 19; 30 inch lengths.

Spaghetti Tubing

Oil, moisture, acid proof; highly dielectric — used by leading engineers. Nine colors, for wire sizes 12 to 18; 30 inch lengths. (We also make tinned bus bar, round and square, in 2 and 2½ ft. lengths.)

Stranded Enameled Antenna

Best outdoor antenna you can buy. Seven strands of enameled copper wire. Presents maximum surface for reception, resists corrosion; this greatly improves the signal. Outside diameters equal to sizes 14 and 16. (We also offer solid and stranded bare, and stranded tinned antenna.)

Loop Antenna Wire

Sixty strands of No. 38 bare copper wire for flexibility, 5 strands of No. 36 phosphor bronze to prevent stretching. Green or brown silk covering; best loop wire possible to make.

Battery Cable

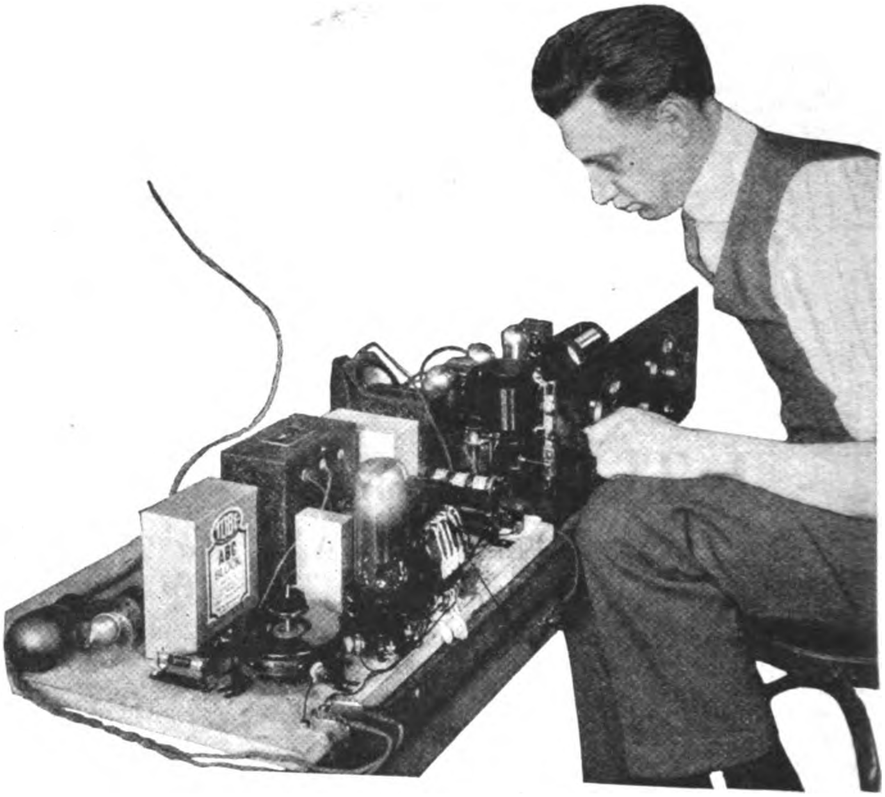
A rayon-covered cable of 5, 6, 7, 8 or 9 vari-colored Flexible Celatsite wires for connecting batteries or eliminator to set. Plainly tabbed; easy to connect. Gives set an orderly appearance.

Send for folder
THE ACME WIRE CO., Dept. P
New Haven, Conn.

ACME WIRE
MAKES BETTER RADIO

Practical Hints for Operating the New AC Valves

(*Continued from page 147*)



THE STANDARD BROWNING-DRAKE RECEIVER OPERATING FROM THE Q. R. S. POWER-PACK

FIGURE 8: *The power-pack shown here supplies all the "A," "B" and "C" power necessary for the operation of the receiver. The schematic wiring diagram of the unit shown above may be found in Figure 7. Below is a view of the same unit in which all of the parts are designated with letters that correspond with the list of parts at the bottom of this page.*

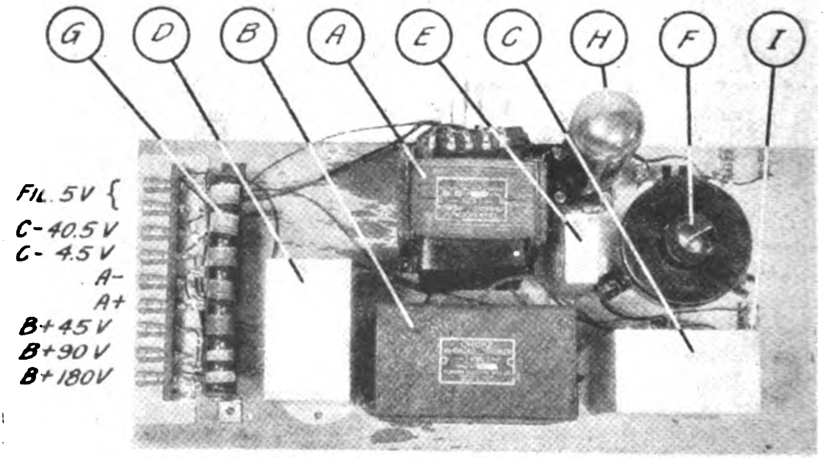


FIGURE 9: HERE IS A LIST OF PARTS NEEDED FOR THIS "ABC" POWER-PACK FOR USE IN FIVE-TUBE RECEIVER OPERATION WITHOUT BATTERIES—

A—Dongan power transformer for 400 m.a. rectifier valve;
B—Dongan choke coil assembly for 400 m.a. rectifier valve;
C—Tobe "ABC" condenser block unit No. 1 for 400 m.a. rectifier valve;
D—Tobe "ABC" condenser block unit No. 2 for 400 m.a. rectifier valve;
E—Tobe special buffer condenser for 400 m.a. rectifier valve;
F—Ward-Leonard vitrohm special variable resistance, 50 ohms at 1 ampere;
G—Ward-Leonard special tapped resistance for 400 m.a. rectifier valve;
H—Benjamin Cle-Ra-Tone vibrationless socket;
1 Amsco fixed resistance, .1 megohm;
1 Q. R. S. 400 milliampere rectifier valve;
2 Fahnestock clips;
1 binding-post strip, 7½ by 1 by 3/16 inch;
1 wooden baseboard, 19 by 9½ by ¾ inch;
9 X-L binding posts.

NOTE: *This "ABC" power-pack is shown here connected to the* NEW *Browning-Drake receiver as described in the April, 1927, issue of* POPULAR RADIO.

A New Form of Radio Waves That Kill

(Continued from page 127)

twig. Some one has compared these masses with the shiny black head of an old-fashioned hatpin. Collect these now; break or cut off the twig containing the egg masses, count them and burn them. For the individuals, schools, Boy Scout Troops and Girl Scout Troops collecting, the greatest number, prizes donated by prominent citizens and organizations will be awarded."

This was the message that was received, and which started a peace-time army to work. For three weeks the army labored on. Each Wednesday evening they received new directions from Mr. Burgess.

To stimulate interest a caterpillar parade was started from the State House in Boston and headed for the Pacific Ocean. Taking the measurement of one full-grown caterpillar as two inches, six would be needed to make one foot. Mr. Burgess suggested that the parade start double-file, making twelve caterpillars to the foot. As the egg masses of the tent caterpillar average two hundred and fifty eggs to the cluster, he figured about seventeen feet of caterpillars for every egg mass. For every thousand egg masses destroyed the parade moved forward a little over three and one-half miles.

So week after week the parade went on. Across the breadth of our country, inch by inch, foot by foot, went crawling a line of furry caterpillars. The first week the parade reached New York State, the second week it was out among the Dakotas, and when the contest was ended it was out in the Pacific Ocean, 3,859 miles from the starting place!

Over 1,102,659 egg masses had been destroyed and over 300,000,000 potential caterpillars were robbed of a life of destruction.

The ace of the entire army of workers was Timothy Golden, an eleven-year-old lad of Washington Depot, Conn. He received the degree of "C. C. C.," (Champion Caterpillar Collector), and $20 in prizes. His return for the three-week period was over 20,000 clusters, or over 5,000,000 potential caterpillars. He picked the caterpillar nests every day after school and on Sundays, using a long pruner eight feet long.

It has been pointed out by prominent agricultural experts that following the splendid example of Mr. Burgess and the Radio Nature League, the extinction of many of the pests so prevalent in our country to-day may be worked out. Maybe they will, now that Mr. Burgess has shown how the trick may be turned.

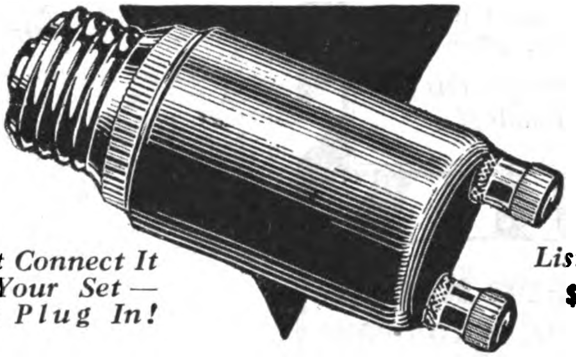
RADIO announcers are gittin' t' be jest like temporary chairmen—they seem t' fergit who th' audience is waitin' to hear.

—*Abe Martin* in INDIANAPOLIS NEWS

Dubilier

The Pioneer

A history of the Dubilier organization takes us back to the very conception of wireless telegraphy. Then, practically every Dubilier device was a "special order" built for experimenters whose names are now famous. Today, these same electrical and radio engineers turn instinctively to Dubilier for either standard articles of manufacture or laboratory models for their research. This keeping step with the industry has given Dubilier a merited reputation for condensers which are way above the average in ruggedness, safety factor and long life.



Just Connect It to Your Set — and Plug In!

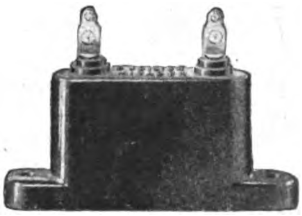
List Price

$1.50

Why Bother With Outdoor Aerials?

Present-day broadcasting and modern receivers don't require them. A Dubilier Light Socket Aerial and a few feet of cord will give you a highly efficient antenna and do away with lead-in wires, insulators, faulty connections and lightning arresters. The device consumes absolutely no current and needs no attention whatever. Works on any cycle, A. C. or D. C. Sold on a 5-day money-back basis.

Price $1.50

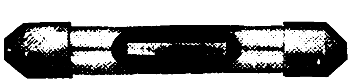


The Approved Condenser Blocks for Radio Power-Units

Dubilier condenser blocks for Raytheon and other leading circuits are rugged in construction, and have the unusually high factor of safety of better than five to one—insuring the longest condenser life obtainable. Your dealer will gladly supply you with the right Dubilier Block Condenser for the right purpose.

A New Dubilier MICADON Moulded in Bakelite

Here's the famous Dubilier *Micadon* in its modern shape and new case of rich Bakelite. Compact, handsome and efficient. Terminals adapted to screwed or soldered connections. Your dealer has them in all capacities. Prices . . . . 40c to $1.50



The Noiseless Dubilier Metaleak

A tubular grid leak you can bank on for accurate resistance value and noiseless operation. Your dealer has them in all values from 20,000 ohms to 5 meg. ohms. Prices . . . . 50c and 75c

Dubilier Condenser Corporation

4377 Bronx Blvd., New York

The obverse of the medal; the original is two-and-one-half inches in diameter.

The reverse; the name of each recipient will be engraved in the space provided.

The Popular Radio Medal *for* Conspicuous Service

TO every radio amateur, to every amateur experimenter and broadcast listener, who is instrumental in alleviating human suffering or saving human life, directly through the medium of radio, recognition will hereafter be extended in the form of a medal that shall be known as "The Popular Radio Medal for Conspicuous Service." This medal is unique within the realms of radio, in that it shall be awarded not for scientific achievement or invention, but for service to humanity.

To insure a fair and unbiased consideration of all claims, a Committee of Awards has been appointed that includes five distinguished citizens of international fame. To assist this Committee of Awards, an Advisory Committee has been appointed that numbers among its members some of the most eminent citizens of the United States, including representatives of many of our most distinguished institutions.

The conditions under which the medal will be awarded are here specified:

1. The medal shall be known as the Popular Radio Medal for Conspicuous Service.
2. The medal shall be awarded, without discrimination as to sex, age, race, nationality, color or creed, to those radio amateurs, radio experimenters, broadcast listeners and other non-professionals through whose prompt and efficient action radio is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life within the territorial confines of the United States and its possessions, or in the waters thereof.
3. The medal shall be awarded by a Committee of Awards that shall not exceed five in number. No member of this Committee shall be an employee, officer or stockholder of POPULAR RADIO, INC., nor shall any such employee, officer or stockholder have a vote in the deliberations of the Committee.
4. An Advisory Committee, which shall co-operate with the Committee of Awards and which shall be particularly charged with the responsibility of making recommendations for awards of this medal, shall be made up of men and women who, because of their interest in the public welfare or because of their connection with institutions that are consecrated to public service, are in positions to bring to the attention of the Committee of Awards the exploits of candidates who are within their own special fields of activity.
5. The medal will be awarded for services rendered since Armistice Day, November 11, 1918.
6. Recommendations for awards may be submitted to the Committee of Awards at any time and by any person. Every recommendation must contain the full name and address of the candidate, together with a detailed account of the accomplishment on which the proposed award is based, and must be accompanied by corroboratory evidence from persons who have first-hand knowledge of the circumstances and whose statements may be verified to the satisfaction of the Committee of Awards.
7. The medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize.
8. All considerations not specified herein shall be left to the discretion of the Committee of Awards.

All communications to the Committee of Awards may be addressed to—

The Secretary of the Committee of Awards, POPULAR RADIO Medal for Conspicuous Service, 627 West 43rd Street, New York.

The Committee of Awards

HIRAM PERCY MAXIM, *President of the American Radio Relay League.*
E. F. W. ALEXANDERSON, *Chief Consulting Engineer of the Radio Corporation of America.*
MAJOR GENERAL CHARLES MCK. SALTZMAN, *Chief Signal Officer of the Army.*
REAR ADMIRAL W. A. MOFFETT, *Chief of the Bureau of Aeronautics, U. S. Navy.*
DR. JOHN H. FINLEY, *publicist and journalist.*

Secretary: Dr. E. E. Free, 627 West 43rd Street, New York.

Advisory Committee

SENATOR JAMES W. WADSWORTH, JR., *of New York.*
HON. JOHN BARTON PAYNE, *Chairman, American Red Cross.*
ADOLPH LEWISOHN, *publicist.*
JUDGE BEN S. LINDSAY, *late of the Juvenile and Family Court, Denver, Col.*
DR. J. MCKEEN CATTELL, *Past President, American Association for the Advancement of Science.*
DR. J. H. DELLINGER, *Past President, Institute of Radio Engineers.*
FARLEY OSGOOD, *Past President, American Institute of Electrical Engineers.*
C. E. GRUNSKY, *Past President, American Society of Civil Engineers.*
DR. DAYTON C. MILLER, *President, The American Physical Society.*
W. L. ABBOTT, *President, The American Society of Mechanical Engineers.*
W. J. HOLLAND, *President, Carnegie Hero Fund Commission.*
GEORGE K. BURGESS, *Director, Bureau of Standards.*
COLIN H. LIVINGSTONE, *Past President, Boy Scouts of America.*
DANIEL C. BEARD, *Chairman, National Court of Honor, Boy Scouts of America.*
MISS SARAH LOUISE ARNOLD, *President, Girl Scouts.*
DR. W. D. HAGGARD, *President, American Medical Association.*
K. A. BICKEL, *President, United Press Association.*
KENT COOPER, *General Manager, The Associated Press.*
H. P. DAVIS, *Vice-President, Westinghouse Electric & Manufacturing Company.*
DR. VERNON KELLOGG, *General Secretary, National Research Council.*
JESSE LYNCH WILLIAMS, *Past President, Authors' League of America.*
PROFESSOR GEORGE B. PEGRAM, *Dean of the Faculty of Applied Science, Columbia University.*
PROFESSOR H. H. SHELDON, *Professor of Physics, New York University.*
WM. HAWLEY ATWELL, *Grand Exalted Ruler, Order of Elks.*
PROFESSOR EDWIN B. WILSON, *Harvard University, National Academy of Science.*
W. E. HARKNESS, *Vice-President, American Telephone & Telegraph Company.*
WILLIAM L. SAUNDERS, *President, United Engineering Societies.*
COL. J. R. MCQUIGG, *Past Commander, The American Legion.*
JOHN R. MOSS, *President, Kiwanis International.*
W. D. TERRELL, *Chief Supervisor of Radio, Department of Commerce, Washington, D. C.*

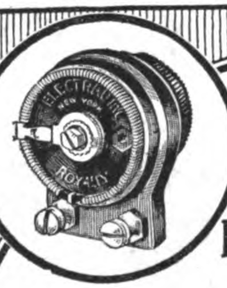
BIG RADIO CATALOG

From the "Big, Friendly Radio House"

NEW 1928 Book offers finest, newest well-known sets; parts, eliminators, accessories at lowest prices. Set-builders, dealers, agents—

Write for this Catalog!

Western Radio Manufacturing Company
136 West Lake Street
CHICAGO, ILL.



Exclusively Licensed by Technidyne Corporation Under U. S. Patent No. 1593658, July 27, 1926.

Dependable!

ELECTRAD Royalty Variable High Resistances

Reception from your radio depends upon the quality and efficiency of even its smallest parts. That's why fans everywhere insist on Electrad Royalty wherever variable high resistances are required.

Electrad Royalty Resistances are acknowledged superior because (1) Same resistance always secured at same point, (2) contact made positive by metallic arm on wire-wound strip, (3) resistance element not exposed to mechanical wear.

A range for every purpose, designated A to L. Type E, $2.00. All other types, $1.50.

Write for free hook-up circular

175 Varick Street Dept. 59A New York, N. Y.

ELECTRAD Inc

Thought-Waves *via* Ether

(Continued from page 113)

realize that the conditions of this experiment were unfavorable, but will think it possible that every trace of this faculty has not evaporated, among sufficiently sensitive people, even under these untoward conditions. Though surely it must need an odd kind of concentrated attention to arrive, by any means, at the ideas of a small group in a London room, rather than at those of a myriad other people, relatives and others, in every part of the kingdom.

There *is* a sort of hypothesis which might account even for this special kind of information, but it would be regarded by the great majority as too wildly speculative—as perhaps it is.

A Radio Fan Captures a Flying Lunatic

During the World War, Stephan Gasoith was a distinguished pilot in the Hungarian air force. One day, while flying over Ampezzo, he crashed to the ground. He had a miraculous escape from death, but when the wounds in his head were healed it was found that he was bereft of reason.

Through the inattention of a warder, he escaped from his prison and made his way to an airdrome five miles away, where he stole an airplane and swiftly vanished toward the south.

When the alarm was given at the asylum, he was traced to the airdrome, where it was discovered that he had escaped by air. A telephone call to this effect from the airdrome to the Budapest radio station induced the operator to broadcast a warning to all stations that this dangerous lunatic was flying about—somewhere.

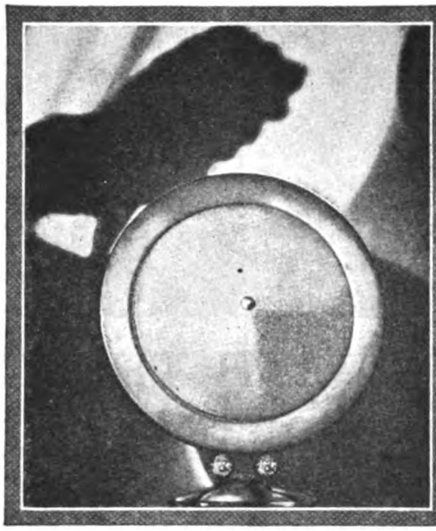
In the town of Turnu Severin on the Danube, just below the iron gates at the foot of the Carpathian Mountains, was only one radio set; it belonged to one of the masters at the local *lycee.* This fan's small boy, aged twelve, was listening in that night to see what he could pick up, and he caught the Budapest call.

The boy understood the French message and in great excitement ran to the nearby station where he told the chief of police what he heard.

Orders were given to keep a lookout on the whole district. And as fate would have it, a little over an hour later, an airplane was seen coming over the crest of the Carpathians from the north. It volplaned gracefully down and landed on a flat piece of meadow on the left bank of the Danube, just below the remains of Trajan's bridge. A couple of officials were rushed to the spot in a motor car.

And there stood the lunatic aviator, ruefully examining his stolen motor!

—BERTHA STREETER.



The LION

New Amplion Cone AC21. Price, $25.00. Height, including handsome bronze base, 22½".

The unit in the Cone is the new Amplion balanced armature type, non-adjustable, with straight bar magnets of the highest grade English tungsten steel.

The Lion combines a 14" Cone with an 18" Sound Board extended at the back towards the center, forming a resonating chamber. This construction enables the Cone to reproduce with absolute fidelity all the notes—high and low—that your set detects.

How much is your radio set worth?

—not in terms of dollars, but in terms of loud speaker reproduction. That's the way to determine its value.

FOR proof of this, do not fail to have a demonstration of an Amplion—no matter what *set* you have or consider buying.

The Amplion line includes models from $20.00 to $145.00—one for every radio reproduction requirement. Amplion prestige back of every model. Write for descriptive literature.

THE AMPLION CORPORATION OF AMERICA
531-535 West 37th Street, New York

Mathematics or Results—Which?

You can't get away from "variables" in the radio power unit. Line voltage fluctuations, changes in receiver tubes, differences in rectifier tubes, lowered rectifier output with age, unequal drain for different yet inter-related circuits—well, there are many "variables" present for which you must compensate with suitable resistance values.

Of course, if you prefer to work the slide rule, by all means get the fun out of figuring resistance values. And don't forget to change the resistors from time to time to compensate for changing conditions.

But if you are seeking the best results with the least trouble, then use variable resistors to take care of all "variables." And when you say variable resistor that means

CLAROSTAT

Mfd. by American Mech. Labs., Brooklyn, N. Y.

CAUTION! CLAROSTAT is being imitated. For your protection, look for the name stamped on the shell.

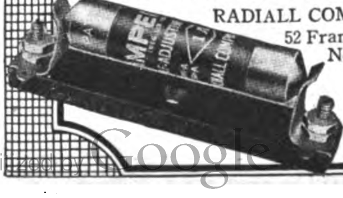
The Watch Dog of Your Tube
F-
P
TO A BATT.

FREE
Write today for "The Radiall Book" with Hook-Ups and construction data to Dept. PR9

Perfect Tube Performance demands AMPERITE
REG. U.S. PAT OFF.
The "SELF-ADJUSTING" Rheostat

Amperite alone can give you full value from your tubes. Guarantees perfect filament current control under every condition—automatically. Don't accept substitutes claimed just as good. Insist on Amperite. It is the only automatic, variable filament resistance—and nothing else will do. Eliminates hand rheostats. Simplifies wiring. Price $1.10 mounted (in U. S. A.). Sold everywhere.

RADIALL COMPANY
52 Franklin St.
New York



Townsend
"B" Socket Power
"Best in World!"
Says A. W. GALE
of Gloversville, N. Y.

COMPLETE

Only $6.85 $1.00 Down Balance C.O.D.

Below is a reproduction of Mr. Gale's letter of May 8th, 1927.

48 W. Fulton St.,
Gloversville, N. Y.

"Received the Townsend all O. K. *It is the best in the World and that is saying some.* I have a Radiola 4 tube. Get more stations than ever before. Some of them are CFCF, CKNC, WGY, KDKA, WGZ, WIP, WWJ, KTHS, KOP, KOA, WHAS, WTAM and KSD—besides 4 in Chicago, all in the East and then some."
A. W. Gale.

Replaces "B" Batteries

The letter above speaks for itself—proves beyond doubt that the Townsend "B" Socket Power is the most remarkable value in Radio today. Sam E. Fry of 1415 Holmes St., Kansas City, Mo., writes: "Eliminator works fine. Showed it to a friend and he wants one also. I will say it sure beats batteries. I get stations I never got before on a 6 tube set." Charles Ellis, 88 Jones Ave., Columbus, Ohio, says, "Your Eliminator is working fine. Have had station WJAX and others over 1,000 miles distant. Picked up 22 different stations one evening and around 30 another time. My neighbor has a $27.50 Eliminator and I don't see that it works any better than yours."

Delivers up to 100 volts on any set, on D. C. or A. C.—any cycle. Full tone, clarity and volume.

Tested and approved by America's leading Radio authorities—Radio News and Popular Radio Laboratories

ORDER TODAY!

Simply fill out the coupon and slip it into an envelope with only $1.00 and mail at once. Your Townsend "B" Socket Power Unit will be sent promptly. Deposit only $5.85 plus postage with the postman. Try out for 10 days—then if not delighted with improvement in reception, return it to us and purchase price will be refunded.

TOWNSEND LABORATORIES
713 Townsend St., Dept. 19, Chicago, Ill.

Attach Only $1.00 to this Coupon!
SEND TODAY

10 Days FREE TRIAL You are the Judge!

TOWNSEND LABORATORIES
713 Townsend St.
Dept. 19, Chicago, Ill.

Gentlemen: Attached find $1.00. Kindly send at once Townsend "B" Socket Power Unit, C. O. D., for $5.85, plus postage, on guaranteed 10-day free trial.

Name..
Address..
City........................*State*...............

WITH THE EXPERIMENTERS

CONDUCTED BY S. GORDON TAYLOR

A Micro-Condenser Measuring Set

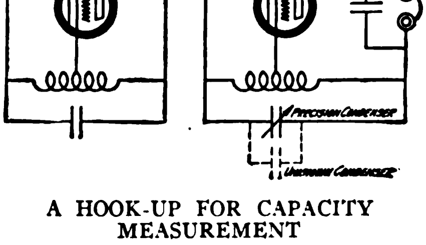
THE determination of very small capacities, such as those which exist between the electrodes in a vacuum valve, is an important matter to the radio experimenter and engineer, and is often inadequately done with a resulting error due to the unsatisfactory methods employed.

For several reasons the ordinary resonance methods are useless in making such measurements.

The usual method of measuring these capacities is known as the "substitution method," in which the output of a high-frequency generator is used to excite a wavemeter circuit. The condenser to be measured is shunted across the main condenser in the wavemeter circuit. Resonance is obtained in this way, as indicated by the thermo-galvanometer. The unknown condenser is then removed and resonance is again obtained. The difference between the two capacity settings of the main condenser is then the capacity of the unknown condenser.

This method is simple and can be applied accurately to large condensers, but when it comes to measuring small condensers—of the order of, say, 50 micromicrofarads or less—the broadness of tuning will introduce inaccuracies which are often greater than the capacity to be measured.

Another method of measurement utilizes the phenomenon of "zero-beat." A high-frequency oscillator is set at a convenient frequency. An oscillating receiver with a pair of headphones in the output is then coupled to it and so tuned that the audible beat between the two is reduced to zero. A calibrated precision condenser is used for tuning the oscillating receiver. The unknown condenser is then shunted across the terminals of the precision condenser, and the capacity of the latter is decreased until "zero-beat" is again obtained. As before, the capacity of the unknown condenser is then equal to the difference between the two capacities of the precision condenser.



A HOOK-UP FOR CAPACITY MEASUREMENT

FIGURE 1: *The diagram shows an oscillator coupled to a regenerative receiver for producing "zero-beat."*

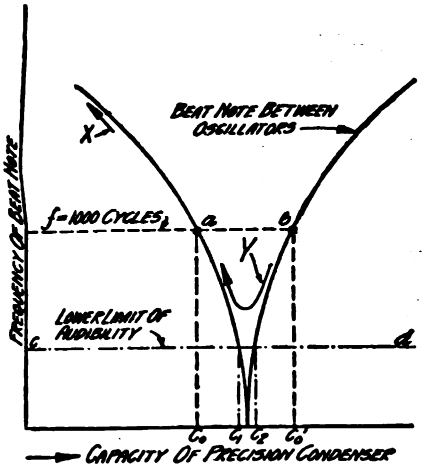
Even in the case where capacity bridges are available the precision obtained depends upon the resistance of the condenser being measured. Due to the fact that these measurements are invariably made at low frequencies (generally 1,000 cycles per second) at which frequencies the resistance of condensers is relatively high, the resistance arms of the bridge must be variable throughout a great range, if the bridge is to be applied to the measurement of condensers of various types.

The method described here is an extension of the "null" or "zero-beat" method described above. It was originally used by Prof. Whiddington of the University of Leeds, England, for use in special research work.

Before describing the method it will be well to point out some difficulties of the "zero-beat" method.

Glancing at Figure 1, we see at the left a fixed-frequency generator. At the right we see an oscillating receiver with a pair of headphones in the output. The precision condenser is tuned until "zero-beat" is obtained. It will be found that as the precision condenser is tuned the beat note will come into audibility as a high note and will then become steadily lower until it goes below audibility. This infra-audible condition will continue as the condenser is turned further until at last the beat note is heard again as a low note. But this time it is rising in pitch until it reaches the upper limits of audibility again.

Now, somewhere between the points where the beat note disappears on its way down, and where it appears again



A CHART SHOWING THE RANGE OF A BEAT NOTE

FIGURE 2: *This chart illustrates the improved method used in balancing two capacities to a greater degree of accuracy.*

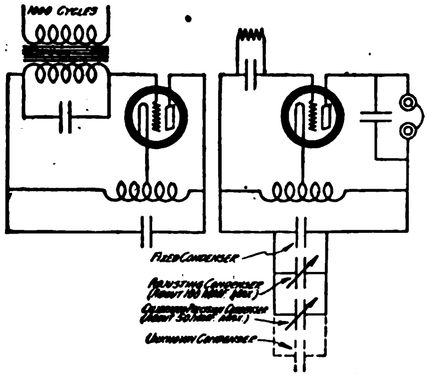
on its way up, is the "zero-beat" point. The silent or infra-audible range occurs when the beat note is below audibility, or below about 32 cycles pėr second. The amount of change in the capacity of the condenser which is made while passing over this silent range may often be as great as 5 or 10 micromicrofarads; so it is evident that in measuring vacuum valve capacities the error may be as great as the unknown capacity itself.

This idea is represented graphically, in an exaggerated way, in Figure 2. The curve shows how the beat note varies as the tuning condenser is varied. The broken horizontal line *cd* is the lower limit of audibility. The graph shows clearly that no beat note will be heard between the values C_1 and C_2 of the tuning condenser, and since it is difficult to tell just when we lose track of the beat note and when we hear it again, we cannot even tell approximately where the "zero-beat" occurs.

This difficulty is avoided by using a *datum frequency* as *f* on Figure 2. This may conveniently be placed at 1,000 cycles, as this is generally available in most laboratories. This *datum frequency* is made to beat against the beat note produced by the two high-frequency oscillators. When the beat note (due to the oscillators beating together) is not exactly 1,000 cycles, a secondary beat will be heard, just as if we had two sounds differing in frequency by a small amount.

As a matter of fact, this is what Prof. Whiddington did; he amplified the beat note of the oscillators and passed it into a loudspeaker. Then another frequency, such as 1,000 cycles, was made to operate a second reproducer. When the reproducers were placed close together, beat notes were heard.

The method is therefore apparent. By noting the disappearance of the secondary beats from the two horns, the oscillators are adjusted until the beat note coincides exactly with the 1,000-cycle note. Then the condenser to be measured is connected in shunt with the precision condenser in the oscillating receiver and the latter is again adjusted until the secondary beats again disappear. The difference between the two capacities of the precision condenser is then exactly equal to the unknown capacity. In making such measurements one must be careful to stay always on the same side of the "zero-beat" or silent spot. The reason for this may be seen in Figure 2.


1000 Cycles
Fixed Condenser
Adjusting Condenser (About 100 MMF. Max.)
Calibrated Precision Condenser (About 50 MMF. Max.)
Unknown Condenser

A MODIFIED SCHEME FOR CAPACITY MEASUREMENT

FIGURE 3: *The diagram shows a modification of Prof. Whiddington's scheme in which a 1,000-cycle buzzer modulates the output of the fixed oscillator.*

Suppose we have the unknown condenser connected to the precision condenser and we resonate the beat note with the 1,000-cycle note, making the secondary beats zero.

This places us at the point *a* of Figure 2.

Next, we remove the unknown condenser. The total capacity being decreased, the beat note will rise as indicated by the arrow *x* and, in general, will go out of audibility. In order to bring the beat note back to where it was, the capacity of the precision condenser must be increased to the value C_0, corresponding to the point *a*. If by mistake we cross the silent region C_1-C_2 and resonate to the point *b*, we shall make an error in the measurement equal to the difference between C_0 and C_1.

On the other hand, if we resonate at *b* with the unknown condenser "on," when we remove the latter the beat note will travel as indicated by the curved arrow *y*, and in order to come back to *b* we shall have to pass over the region of silence.

This may appear to be complicated, but after a few trials it will be found to work out simply, especially because the error created by making a wrong choice of the points will be so great as to tell us immediately of that error.

Furthermore, we generally have a fair idea of what the unknown capacity is going to measure. For instance, in vacuum valves of the ordinary type, we can expect to have capacities somewhere

NEW AERO CIRCUITS WORTH INVESTIGATING

The Improved Aero-Dyne 6 and the Aero 7 and Aero 4 are destined to be immensely popular this season!

Here are three new Aero circuits of unusual merit. Each is constructed around a set of improved Aero Universal Coils—the finest and most adaptable inductances ever offered! Learn about them NOW if you are interested in securing finest selectivity, greatest range and power, truest tone quality and best all-around radio reception.

AERO UNIVERSAL TUNED RADIO FREQUENCY KIT

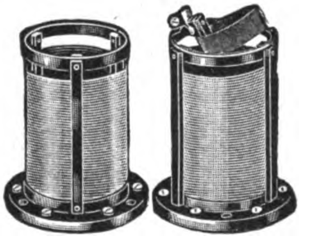
Especially designed for the Improved Aero-Dyne 6. Kit consists of 4 twice-matched units. Adaptable to 201-A, 199, 112, and the new 240 and A. C. Tubes. Tuning range below 200 to above 550 meters.
This kit will make any circuit better in selectivity, tone and range. Will eliminate losses and give the greatest receiving efficiency.

Code No. U-16 (for .0005 Cond.)....... $15.00
Code No. U-163 (for .00035 Cond.)..... $15.00

AERO SEVEN TUNED RADIO FREQUENCY KIT

Especially designed for the Aero 7. Kit consists of 3 twice-matched units. Coils are wound on Bakelite skeleton forms, assuring a 95% air dielectric. Tuning range from below 200 to above 550 meters. Adaptable to 201-A, 199, 112, and the new 240 and A. C. Tubes.

Code No. U-12 (for .0005 Cond.)...... $12.00
Code No. U-123 (for .00035 Cond.)..... $12.00



AERO FOUR KIT

An exceptionally efficient kit for use in the Aero 4 and other similar circuits. Consists of one Aero Universal Radio Frequency Transformer and one Aero Universal 3-Circuit Tuner. Uses 201-A, 112, 199 and new A. C. Tubes.

Code No. U-95 (for .0005 Cond.)....... $8.00
Code No. U-953 (for .00035 Cond.)..... $8.00

A NEW SERVICE

We have arranged to furnish the home set builder with complete Foundation Units for the above named Circuits and for the Chicago Daily News 4-Tube Receiver and the Aero Transmitter Set, drilled and engraved on Westinghouse Micarta. Detailed blueprints and wiring diagram for each circuit included in foundation units free. Write for information and prices.

You should be able to get any of the above Aero Coils and parts from your dealer. If he should be out of stock order direct from the factory.

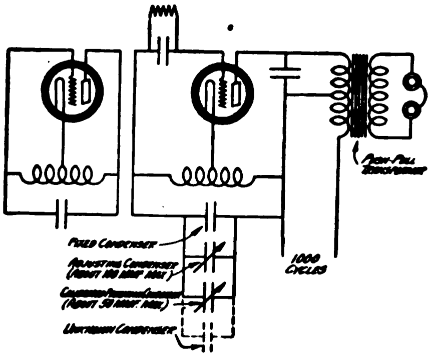
AERO PRODUCTS, INC.

Dept. 104

1772 Wilson Ave., Chicago, Ill.

FREE
Greater Values are Shown in our New Big 1928 Dealers' Catalog
EVERYTHING new and desired—all under one roof. You don't need to look elsewhere. Complete stock carried. Prompt, efficient, dependable service.
Write for your copy today. See what you SAVE.
New Kits featured include: Aero—Bodine—Camfield—Citizens—H-F-L—Infradyne—Karas—Melo—Heald—Scott's—Silver Marshall—St. James—Tyrman—etc.
Established 1918
TELEPHONE MAINTENANCE CO.
123-G South Wells Street Chicago, Illinois
CHICAGO'S OLDEST RADIO HOUSE
WHOLESALE ONLY

XL Products
Pep up Your Set!
Model "N" Vario-denser
Tune quickly—adjust accurately—eliminate distracting noises—get correct tube oscillation—with X-L VARIO DENSERS in your circuit. Designers of all latest and best circuits specify and endorse.
MODEL "N"—Micrometer adjustment easily made, assures exact oscillation control in all tuned radio frequency circuits, Neutrodyne, Roberts 2-tube, Browning-Drake, Silver's Knockout. Capacity range 1.8 to 20 mfd. Price, $1.00.
MODEL "G"—Obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in superheterodyne and positive grid bias in all sets. Capacity range. Model G-1 .00002 to .0001 Mfd. Model G-5 .0001 to .0005 Mfd. Model G-10 .0003 to .001 Mfd. Price, each, with grid clips, $1.50.
X-L PUSH POST—Push it down with your thumb, insert wire, remove pressure, wire is firmly held. Vibrations will not loosen, releases instantly. A push post that excels in appearance, action, service and convenience. Price, each, 15c.
PUSH POST PANEL—7 push posts mounted on black insulating panel with permanent white markings. Soldering lugs, raising bushings, screws for mounting, etc., in box complete. Price, $1.50.
X-L Push Post
X-L Push Post Panel
FREE wiring diagrams showing use of X-L units in the new LOFTIN-WHITE constant coupled radio frequency circuit, and in other popular hook-ups. Send for yours today.
XL Radio Laboratories
2422 Lincoln Ave., Chicago, Ill.


Push-Pull Transformer
1000 Cycles
Fixed Condenser
Adjusting Condenser (About 100 Mmf. Max.)
Calibrated Precision Condenser (About 50 Mmf. Max.)
Unknown Condenser

ANOTHER MODIFICATION OF FIGURE 1

FIGURE 4: *This diagram shows a method for utilizing a push-pull transformer for mixing the beat note and the 1,000-cycle note used in obtaining a precision balance.*

between 5 and 20 micromicrofarads.

The method of using the two reproducers is not entirely satisfactory, not only on account of the extra equipment necessary, but also because the secondary beats may not be defined sharply enough. There are two modifications of Prof. Whiddington's scheme in use by the writer, both of which have been found satisfactory. In the one case the fixed oscillator at the left of Figure 1 is modulated by the 1,000-cycle buzzer in any of the customary ways.

This is illustrated in Figure 3.

The other method is illustrated in Figure 4.

In the latter case a push-pull transformer is used as a mixing transformer for combining the beat note and the 1,000-cycle note. The two notes are by this means heard simultaneously in the phones, and the secondary beats are sharply defined. As a matter of fact, it is possible to distinguish even a few of the secondary beats resulting from the harmonics of the 1,000-cycle buzzer and of the oscillators.

The next item to consider is the precision condenser.

The one used by the writer and found to be satisfactory is a semicircular two-plate variable condenser having a maximum capacity of about 50 micromicrofarads. This was calibrated at several points by making extremely careful measurements on a capacity bridge. A semicircular plate condenser was selected in order to be sure that the calibrating measurements fall in a straight line. The condenser should not be used on the first and last ten divisions of the dial.

The oscillating receiver is adjusted to approximately the same wavelength as the oscillator by means of the fixed condenser. A two-plate condenser is used to make the initial adjustment for zero secondary beat. The procedure is as follows:

Set the precision condenser fairly high on the dial; tune the adjusting condenser until zero secondary beat is obtained. Connect the condenser to be measured in shunt with the latter and tune the precision condenser until zero secondary beat is obtained again. The amount which the precision condenser has to be changed is equal to the capacity of the unknown condenser.

The set built by the writer is used most for obtaining the capacity of vacuum valves, and for this reason a valve socket was mounted on the panel and a switching arrangement provided in order to connect the various elements in shunt with the precision condenser. All the wiring must be made rigidly, and every time a switch is thrown the initial adjustment must be made again. The instrument is extremely sensitive to small changes of capacity; the change of capacity of a single piece of wire 5 or 6 inches long attached to one terminal of the precision condenser can be easily detected. Using a 50 micromicrofarad condenser, it will be seen that a quarter of a division change means 1/8 micromicrofarad change. The accuracy of the measurements depends upon how accurately the precision condenser has been calibrated.

Care must be taken that body capacity does not influence the measurements. In the set-up used by the writer, 12-inch bakelite rods were used to operate the dials.

The instrument proves to be serviceable and accurate. Furthermore it is easy to operate; a single measurement requires only about half a minute to make. The whole test set is housed in an ordinary radio receiver cabinet.

—SYLVAN HARRIS.

Rejuvenating Weak "B" and "C" Batteries

RADIO "B" and "C" batteries that are partly run down can be temporarily pepped up by drilling a series of small holes into the battery and then filling the holes with a solution composed of either sal-ammoniac, vinegar, or diluted sulphuric acid. The battery should be allowed to stand idle for several hours before using, after which additional acid should be added. The holes can be plugged up with sealing wax or soft soap.

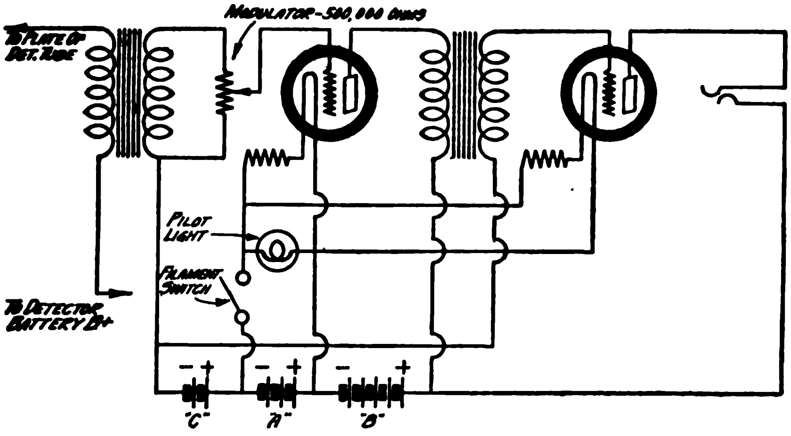
—L. C. FERGUSON

Corroded Connections Decrease Sensitivity

I EXPERIENCED some trouble with the coils of the LC-27 receiver that I built when the hollow rivets that hold the soldering lugs became corroded. The corrosion made them poor conductors and the sensitivity of the receiver decreased accordingly. I scraped the terminals and soldered them over again, taking care to solder rivets, lugs and wire into a solid connection.

As a result the set is now working better than ever and is more selective.

—J. E. FAUNCE.



A COMBINATION DEVICE THAT SIMPLIFIES RECEIVER OPERATION

FIGURE 5: *A single control operates the modulator at the upper left of the diagram and the filament switch below it.*

Audio Volume Control

SIMPLICITY is the vogue in modern set design. The new switch-type modulator is one of the latest devices with that object in view. It can be added to any type of low-frequency amplifier, and will provide a volume control, besides taking the place of the regular filament switch. If some form of automatic filament control is used, this improved modulator is the only control that is necessary to be put on the panel of the amplifier. The modulator is a potentiometer which has a resistance that can be varied from zero to 500.000 ohms, thus giving complete control over the degree of amplification. A switch that automatically turns the filaments of the tubes "on" and "off" is incorporated in the new modulator. When the modulator knob is turned to the left, it brings the grid connection nearer to the filament end of the resistor winding and decreases the volume. The filament circuit is broken when the modulator knob is turned to the extreme left. When the blade is in the center of the resistor, the volume is one half the full value. Rotating the modulator toward the right lights the filaments of the tubes and increases the volume. When the knob is turned to the extreme right, the amplifier is operating at its full output. The modulator is connected in a transformer-coupled amplifier in the manner shown in Figure 5. If the amplifier uses impedance or resistor coupling, the resistor winding of the modulator can be substituted for the grid-leak on the second tube and the blade of the modulator connected to the grid of the same tube. All that is needed on the panel of a low-frequency amplifier is a modulator of this type, and a single filament-control jack connected to the output of the amplifier. A pilot light connected across the filaments of the tubes and mounted behind a ruby lens in the panel will serve to show when the tubes are lighted, so that there will be no chance of the operator accidentally leaving the set on.

—CHARLES F. FELSTEAD.

Improving the High-Frequency Receiver

THE present-day high-frequency receiver leaves little to be desired in the way of simplicity, selectivity and sensitivity, provided it is properly built, balanced and perhaps shielded when employed in cities and particularly in the vicinity of powerful broadcasting stations. However, to realize the utmost sensitivity and volume it is sometimes helpful to be able to adjust the plate voltage of both the high-frequency and the detector valves. In fact, many of the present-day manufactured receivers of the high-frequency type are employing variable plate voltage for at least the high-frequency valves.

High-frequency valves are very susceptible as regards the effects of carefully adjusted plate voltage. Instead of employing 67½ or 90 volts, as is the standard practice, it will be found advisable at times to increase the voltage to well over 100, particularly when striving for generally weak signals. On powerful signals, on the other hand, it may be advantageous to reduce the high-frequency plate voltage to 45.

A most satisfactory arrangement in this connection, irrespective of the type of high-frequency receiver, is to tap the full B-battery output for the high-frequency amplifier plate circuits with an efficient variable resistor. This should be connected between the battery terminal and the high-frequency "B" plus (+) terminal of the receiver.

The variable plate voltage for the high-frequency tubes provides a definite means for compensating between the overload signals from the local broadcasters and the very weak signals from distant stations, by a suitable balancing of the plate voltage.

—CHARLES GOLENPAUL.

Improved Positive VOLTAGE CONTROL for "B" Eliminators

HEAVY DUTY Centralab Variable ResistoR

To carry plenty of power and withstand high voltage this new unit provides outstanding advantages. A single turn of the knob gives full resistance variation. Units are practically heat-proof, and will dissipate up to 20 watts through the entire resistance, without danger of burning out. Resistance remains constant at any knob setting.

Used as improvement over present controls, or add to the "B" eliminator that has no variable voltage. A 50,000 ohm unit attached to high voltage terminal provides a tap adjustable to any voltage. When replacing present controls, use 100,000 ohms for detector and 50,000 ohms for intermediate voltage. Also 10,000 and 500,000 ohms. Each $2.00.

HEAVY DUTY Centralab PotentiometeR

Identical with above Resistor, plus a third terminal. Potentiometers provide better voltage regulation for "B" Eliminators than the two-terminal type and are economical because no fixed resistors are needed. Have ample current carrying capacity for any "B" power circuit. Try this improved regulation on your Eliminator. Resistances up to 10,000 ohms all wire wound. 2,000, 3,000, 10,000, 25,000, 50,000, 100,000 ohms, $2.00.

WIRE WOUND Centralab Fixed ResistoR

Built for the heavy current of A & B power circuits. The wire is wound over asbestos, fixed with heat-proof cement. Ample area. Flat and thin, making them easy to mount. Resistance values for all ABC Power Circuits.

At your dealer's or C. O. D.
Send for the new Centralab A and B power circuit literature

CENTRAL RADIO LABORATORIES
17 Keefe Ave. Milwaukee, Wis.

Centralab
CRL

Great Sensitivity

Made with our exclusive superior feature—the TELEVOCAL SUPPORT — Televocal Quality Tubes won't short and are non-microphonic. Manufactured, tested and balanced by technical experts, they combine sensitivity with high amplification. Insist on Televocal—the quality tube that's guaranteed.

If your dealer cannot supply you, write us giving his name.

Televocal Tubes are made in all Standard Types

TC 201A TELEVOCAL

TELEVOCAL CORP'N,
Televocal Building,
Dept. F, 588—12th St.,
West New York, N. J.

TELEVOCAL QUALITY TUBES

CARTER

New and Complete Line

Molded Mica Condensers By-Pass, Filter and Buffer Condensers

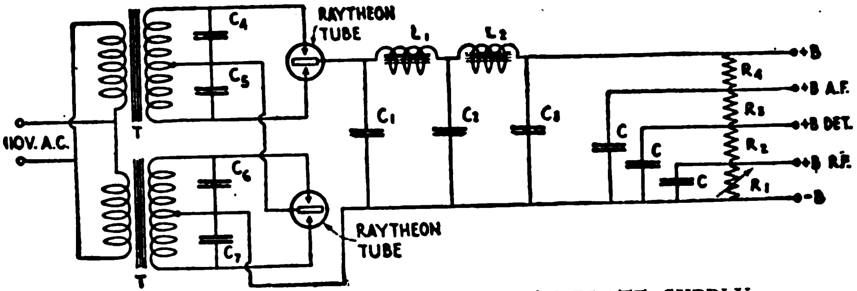
Not affected by climatic or temperature changes. Guaranteed to be and constantly to remain within 10% of rated capacity.

Any dealer can supply.

In Canada: Carter Radio Co., Ltd., Toronto

MEMBER RMA

Carter Radio Co. CHICAGO



A POWER UNIT HOOK-UP FOR HIGH PLATE SUPPLY

FIGURE 6: *The diagram shows a schematic hook-up for a power supply unit that utilizes two rectifier valves to furnish up to 435 volts DC at 85 milliamperes for plate potential.*

Rectifier Tubes for High Plate Supply

As the trend in receiver design seems to be toward higher operating voltages, especially in connection with the UX-210 or CX-310 types of super-power amplifier valves, there is often a desire for doubling the voltage of the usual Raytheon radio power unit. The outputs of two standard Raytheon rectifier valves, connected in series as shown in Figure 6, will furnish plate voltages up to 435 volts DC at 85 miliamperes, when using the type BH Raytheon.

In the set-up shown in this figure, standard designs of transformers and choke coils are employed—the same that are found in the usual "B" power unit employing a single valve. However, two transformers are required, one for each rectifier valve.

The condensers are of the same values as in the standard Raytheon circuit, namely, C-1 and C-2, 2 mfd.; C-3, 8 mfd.; C-4, C-5, C-6 and C-7, 0.1 mfd. However, the condensers should be designed for a *working voltage of* 750. The necessity of having condensers designed and built for this working voltage is to take care of the high voltage which would be delivered if there were no load on the radio power unit, such as when the filament of the UX-210 power valve is not lighted. In fact, care should be exercised that the filament of the power valve is always turned "on" while the "B" power is turned "on." If the "B" power and filament circuits are under one control, this is automatically arranged for; otherwise, peak voltages, even in excess of 750 volts, may be encountered, severely straining the filter condensers, when the radio power unit is working on no load.

The filament of the UX-210 may be operated from raw alternating current supplied by a separate transformer capable of delivering a current of at least 1.25 amperes at 7.5 volts.

While the grid bias can be obtained for the power tube by means of a suitable resistance drop, it is simpler to employ a tapped "B" battery with from 28 to 35 volts in the grid circuit. Since there is virtually no drain on the battery, it should last for a year or more.

Various voltage taps may be obtained by the use of suitable resistance units and by-pass condensers as shown in Figure 1. The resistance bridge may consist of any one of several output resistance units now on the market for use with high-voltage power-packs.

Remarkable volume, together with extreme depth and utmost realism, may be obtained through the use of the UX-210 valve, operating with this double Raytheon arrangement. There is ample voltage available for operating a high-power resistance-coupled amplifier with the UX-210 power valve in the final stage.

—LAURENCE MARSHALL

The Life of Paper Condensers

PAPER condensers do not last forever. They have a definite life based on their materials, construction and design, and on the use or abuse to which they are subjected. Mica condensers, by contrast, have a virtually non-ending life, due to the small load handled in proportion to the strength of the dielectric.

The properly designed and constructed paper condenser, properly applied within its rated voltage, should last over a long period. Good paper condensers, for instance, are designed and constructed for a minimum of 10,000 hours of service at their rated voltage. In actual life tests these condensers usually last for a period corresponding to from 30,000 to 60,000 hours of actual service. In normal use, a minimum life of 10,000 hours represents ten years of typical radio service.

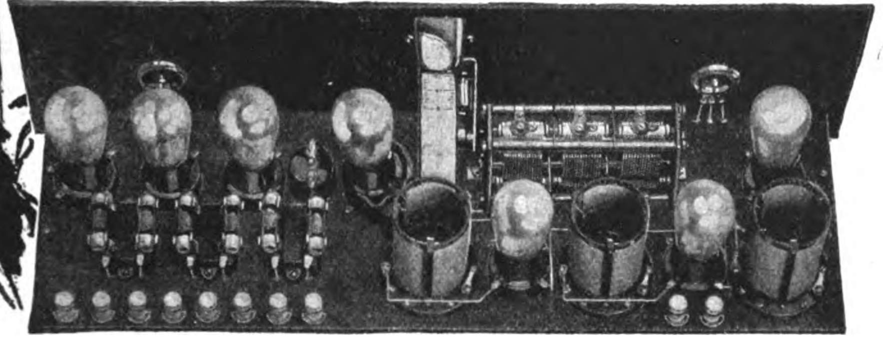
There is no piece of electrical apparatus that is more susceptible to the evil effects of overload than the paper condenser. In fact, a 10 per cent overload on the paper condenser cuts down the life by 50 per cent. If the voltage is doubled, the life is reduced to one-thirtieth of the normal life.

In order to secure long life from the paper condensers used in any assembly, the condensers employed should be of a *working* voltage rating that is ample for the work to be done. It is even preferable to use oversized paper condensers. Under no circumstances should undersized condensers be employed.

—HARRY F. HOUCK.

AERO-SEVEN RECEIVER

10-Kilocycle Selectivity



Utilizing New 340 Tubes & Unique Features

The Aero-Seven Receiver, which is being featured in the prominent radio magazines and newspapers, is a new tried and tested tuned R. F. circuit, incorporating the most modern radio improvements at a popular price. It is a distinct innovation in a tuned R. F. receiver, utilizing three stages of R. F. and three stages of resistance-coupled audio. Circuit is built around the famous improved Aero Universal Coils, with improved Amsco S. L. tuning 3-gang condenser, S-M single-control drum dial and the tried and tested parts of other famous manufacturers. Such names as Carter, X-L, Westinghouse, Aero, Amsco and Silver-Marshall assure you of a circuit that is the final word in perfection.

Distinct features are: the new Hi-Mu tube at input and in R. F. stages, potentiometer control, higher amplification, 10-kilocycle selectivity and true single control,

The Aero-Seven has a broadcast range from below 200 meters to over 550 meters (1500-500 kc) and requires no shielding as with the small Aero coils, direct pick-up is negligible and coupling between coils is the very minimum. The coils are twice-matched at both high and low frequencies of the broadcast band, thus eliminating many difficulties in single dial control and overcoming one of the principle causes of disappointments.

The adjustable compensators on the Amsco condensers facilitate the equalization of circuits, solving the major problem of tandem tuning.

The extremely sharp selectivity of the Aero-Seven circuit is due to the low resistance of the coils. The high voltage gain per stage, due to the extremely low loss construction, assures extreme distant reception and greatest volume and sensitivity is assured through the high efficiency of the coil windings.

New and Unique Hookup
3 Stages of Radio Frequency
3 Stages of Audio Amplification

The Aero-Seven has a new and unique hook-up that incorporates three stages of R. F. and three stages of Audio. There are two stages of tuned radio frequency and a special coupling stage, the secondary function of which is to prevent antenna detuning, thereby giving single control which is both theoretically and practically perfect. This independent antenna circuit is of a new and efficient design and employs a resistance connected between the antenna and ground inputting to the first grid circuit. Five CX340 tubes are used—3 in the R. F. circuit, one detector and one in the audio.

In the three audio stages, one 171 power tube is used, one 201A tube and the one CX340 tube in the input.

The circuit, therefore, is different from the usual 7-tube R. F. circuits, which variations contribute to its optimum selectivity, perfect quality and thrilling volume.

The combination of all the various parts, the matching of the Aero Universal Coils, together with the Amsco compensating 3-gang condenser, with true single control and potentiometer control, greatly simplifies operation and tuning, while adding efficiency to the circuit.

First Use of New CX340 Tubes—1-6/10 Times Better

Utilizing the new CX340 Cunningham tubes in place of the usual 201A, gives the Aero-Seven the distinction of being the first circuit using this superior method. CX340 tubes are 1-6/10 times more effective than 201A tubes, having a 5-volt filament and .25 amperes; plate, 180 volts maximum. In this receiver 90 volts is used constantly on the plate for the R. F. circuit, something seldom attempted but efficiently worked out here. It is a High Mu tube, having a high amplification factor (Mu-30) and is used both as a detector and as a radio and audio amplifier. The Aero-Seven is specially designed to operate with this new and better CX340 tube and the results secured will be a pleasing revelation to you. It is surprising what tone and volume is secured with a minimum use of current.

Resistance Coupled Audio Amplification

Resistance coupled audio amplification in the Aero-7 attains a quality of reproduction unapproachable in other systems. It preserves the extraordinary quality consistently achieved by Aero-7's 10-kilocycle selectivity.

10 Kilocycle Selectivity Now a Real Fact

Ten kilocycle selectivity is OPTIMUM Selectivity. It means a receiver that tunes sharply enough to eliminate interference and yet does not tune so sharply as to cause distortion. It is the ideal tuning characteristic. "Optimum tuning," says the engineer, when he means a perfect set.

Why bother with anything but the best? Why put up with anything but 10-kilocycle selectivity, as represented in the Aero-Seven circuit?

Due to the low-loss construction of the coils and condensers in the Aero-Seven and the great selectivity introduced into the circuit itself, you get selectivity so sharp that you cannot get two stations at one time under present broadcast regulations, at the same time providing adequate frequency margin to prevent high "cut off"—distortion.

Imagine what this means in perfect radio reception. Selectivity, the ability to time in clearly, sharply, without fear of disturbance in getting the station you want whenever you want it—that's something every radio fan has long desired. It is an actuality in the Aero-Seven—a feature that is necessary in an up-to-date circuit—a feature that you get in the Aero-Seven when you build it.

New, Modern, Proved Features in Aero-Seven

10 Kilocycle selectivity.
Resistance coupled amplification.
Uses new CX340 tubes instead of 201A.
3 stages of R. F.
3 stages of audio amplification.
Extreme D-X reception.
Potentiometer control.
Silver-Marshall single drum dial.
True single control.
Aero Coils are twice matched at both high and low frequencies.
Amsco adjustable condensers.
Carter resistances.
Westinghouse Foundation Unit.
X-L Posts.
High quality parts throughout.
Range below 200 to above 550. meters (1,500-500 KC).
Low loss characteristics throughout.
Perfectly compensated—variation in antenna circuit doesn't affect it.
Wiring underneath sub-panel.
Simple construction.
Easy to build in quick time.
The most popular-priced 7-tube circuit.

See article in this issue

The Aero-Seven-tube Receiver assures you of the very latest in radio. It has everything—beautiful tone, 10 kilocycle selectivity—extreme long range and a volume at your command that can be raised to music-hall proportion or lowered to slumbering whispers. The particularly meritorious application of resistance coupling creates a most remarkable tone. It gives you a receiver that is in a class all its own—a real conqueror of space—a companion that you can depend upon absolutely in any emergency. It delivers quality that is quality, and yet its construction is so low in cost as to be almost unbelievable.

An Opportunity for Set Builders

The set builder will find the Aero-Seven a most profitable receiver to build. It is an extremely simple circuit—efficient, high grade and having a record of exceptional performance. It could hardly be duplicated in a factory-built set at double the cost.

You can make big money building this set for your friends and get a real "kick" out of it yourself.

Complete parts, drilled and engraved panels and foundation units are being distributed through the jobbing trade and are available at leading radio stores everywhere. If your dealer cannot supply you, order direct giving your dealer's name and we will see that you are supplied promptly.

A full-size working blueprint and booklet of assembly and operating instructions with complete data is furnished, which makes it both practical and easy to build this circuit quickly. Build yours early—get the jump on the other fellow.

Get the facts. Mail the coupon and 10c stamps for this valuable booklet. Send today—NOW!

Get the Facts—MAIL NOW→

AERO PRODUCTS, INC.
1768 Wilson Ave., Dept. 209, Chicago, U. S. A.

Aero Products, Inc.
Dept. 209, 1768 Wilson Ave., Chicago.

Dear Sirs: Enclosed find 10c for which please send me life-size blueprints, assembly diagrams, construction data and all the facts in building the new Aero-Seven Receiver.

....

Name ....

Address ....

Associated Manufacturers—Amsco, Aero, Carter, Westinghouse-Micarta, Silver-Marshall, X-L

Build Sets make $100.00 a week

GET INTO RADIO GAME

Let us show you how to make money in your spare time building Infradyne receivers. The sale of one set with accessories nets you a substantial profit. The new 1928 Model DX Infradyne will be the season's winner.

PROFITABLE, FASCINATING WORK. START NOW!

Get going now—let us send you complete circulars outlining our entire system. Anybody with ordinary mechanical ability can profit from this new method.

THE SEASON HAS OPENED

August 1st is the opening date of the new radio season. Long distance reception will be good this year. You can make Infradyne demonstrations now and outperform any set on the market.

GET OUR PLAN NOW

The plan is ready for you—now. A post card will bring complete details. Be the first man in your town to get into the INFRADYNE business. Don't delay!

RADIO CONSTRUCTORS CORPORATION
Dept. PR, 357 12th St., Oakland, Cal.

The Coil's the thing that makes Radio

DUDLO

NO RADIO UNIT IS ANY BETTER THAN ITS COIL

The performance of Battery Eliminators, Audio Transformers, Loud Speakers, and all other Radio Units is in exact ratio to the efficiency of their windings. **It's the Coil that does the work!**

Nearly all leaders in radio and radio parts use Dudlo Coils because they know their superiority.

DUDLO

Dudlo Manufacturing Corporation
FORT WAYNE, INDIANA

IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

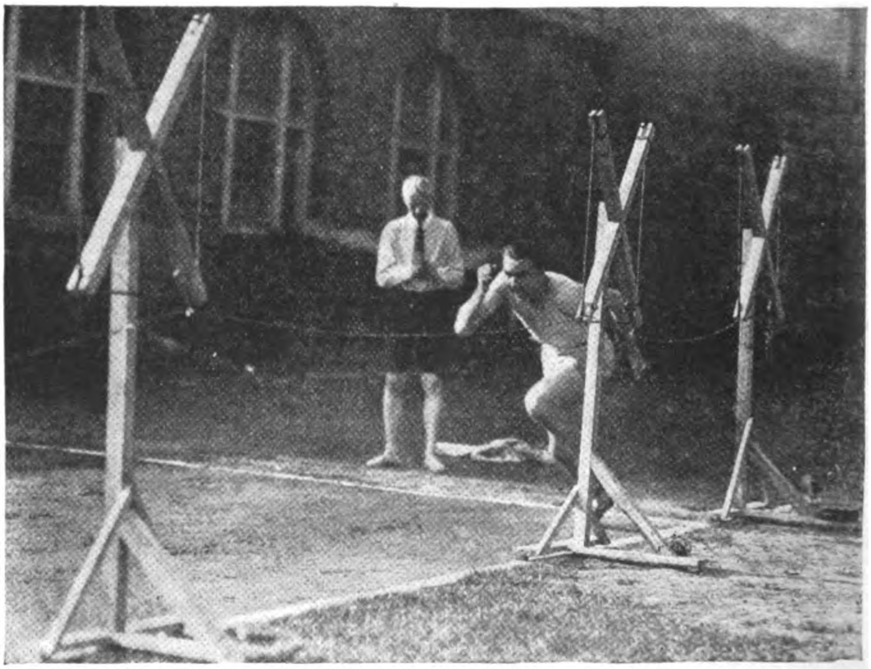
Timing Racers by Radio

PROFESSOR A. V. HILL, distinguished physiologist of the University of London, now lecturing at Cornell University at Ithaca, New York, has contributed to American athletic sports both some new devices and some new ideas. Among the devices is a novel apparatus for timing the races, not only at the finish, but at as many points as desired along the course. This is done by an electric method, depending essentially upon radio waves.

Among Professor Hill's new ideas is one that the performance of a racer, and the record that he can make, will be determined not by any such indefinite factors as "will-power" or "endurance," but by the facts of physiological chemistry—especially by the ability of the racer to supply oxygen to his rapidly breathing muscles during the race.

For several years Professor Hill has been studying this matter of the expenditure of oxygen in the muscles during exercise. The details of the research lie outside the scope of this Department, but it may be said, in briefest outline, that the essential thing is the formation and disposal of a chemical called lactic acid—the same acid that is formed in milk when it sours. This lactic acid is produced in the muscles during exercise. It is disposed of by being oxidized, the necessary oxygen being supplied by the blood. There is also a muscle "food" material, named glycogen. This must be supplied; the lactic acid must be removed.

The bodily machinery for doing these things includes the heart, the blood, the lungs, probably certain glands, and so on. For details, the interested reader must consult Professor Hill's numerous



J. P. Troy, Ithaca

HOW ELECTRIC WAVES ARE USED TO MEASURE THE SPEED OF ATHLETES

The runner carries a small magnet, sewed into his clothes. As he passes each of the wired frames alongside the track the inductive action of the magnet produces a pulse of current in the wire. These pulses are registered on an electric chronograph to which the connecting wires run. In the center, with the notebook, is Professor A. V. Hill, of London, who has been experimenting with this apparatus at Cornell University, Ithaca, New York.

papers, mainly in the *Proceedings of the Royal Society* (London), or some recent textbook on physiology.*

The Department of Chemistry of Cornell University, presided over for many years by the distinguished American chemist, Professor L. M. Dennis, has the good fortune now to possess the Baker Fund, the purpose of which is to bring to America, at intervals, distinguished foreign scientific men who become for a time guest professors and lecturers at Cornell. Professor Hill is here as one of these scientific visitors. While at Cornell he has been extending his work on muscles and other bodily structures† and has put his ideas to the test of practice with members of the Cornell track team and with other athletes of the university.

To readers of POPULAR RADIO the most interesting part of Professor Hill's American investigations will doubtless be the methods devised for timing the exact speed of a runner between any two selected parts of the course.

The usual methods of a tape stretched across the course cannot be used, except at the end of the race, without interfering with the runner, nor are such methods accurate enough for the timing of speed over short portions of the whole race. Human observers, stationed along the course with stop-watches, cannot be depended upon for very small time differences. Errors by the observers are always probable, and there is the "reaction time" needed by each observer to see the runner pass and to press the stop-watch, all of which must be taken into account and corrected for. An electric method is far better.

The electric system installed for Professor Hill's experiments at Cornell is shown in the accompanying illustration. Frames, like loop antennas for radio use, are set up alongside the path which the runner will traverse. The passage of the runner affects, momentarily, the constants of such a loop circuit. This may be registered as an electric signal on recording apparatus at any convenient point.

Although the records actually obtained by Professor Hill were made with an ordinary direct-current galvanometer, it is obvious that any one of many methods of detecting and recording the inductive disturbance of the passing runner might be used. Body capacity effects are perhaps the easiest ones.

---

* The best recent text, in English, is "Principles of Human Physiology," by the late Professor Ernest H. Starling. Fourth edition, 1926, 1074 pages, Lea and Febiger, Philadelphia, Penna. A good account of recent investigations on the physiology of muscular action will be found also in "Recent Advances in Physiology," by C. Lovatt Evans. Second edition, 1927, P. Blakiston's Sons and Co., Philadelphia, Penna.

† His success in measuring the exceedingly tiny amounts of heat emitted by a living nerve when a nervous message passes over it was described by Professor Hill at the meeting of the National Academy of Sciences at Washington, D. C., in April, 1927. See *Science* (Lancaster, Penna.), volume 65, page 452 (May 6, 1927).

POWERIZER

Reg. U. S. Pat. Office

"The Genuine Socket Power"
Will Make a
De Luxe Electric Set
Out of YOUR Set!

POWERIZER will give **ANY** set the famous **POWERIZER** tone and faithful reproduction—obtained by a UX 210 for the last stage—plus genuine, complete ABC elimination by using UX 226's and one UY 227, the new AC tubes. POWERIZER gives a tone to any radio set that is equal to that in expensive de luxe sets and the finest electric phonographs. POWERIZER strikingly improves tone quality and gives ample volume for dancing, concerts, etc. Your dealer will gladly demonstrate POWERIZER in your home, on your own set.

There is a POWERIZER for every set . . . for YOUR set.
Insist on HEARING it!

For Your
Radiola 20

PXY Radiola 20 gives genuine ABC power supply and the marvelous POWERIZER tone to the Radiola 20. Uses NO batteries, liquids or paste. Made complete in a compact, beautifully finished container. Draws between 40 and 50 watts only when set is on. Uses 280 as rectifier and 210 as amplifier. Complete harness and adapters included in output.

List without tubes....... $59.00
With UX 280 and UX 210 73.00
(3-UX 226's, 1-UY 227..$15.00)

For Your
Atwater Kent

PXY A-K gives genuine ABC power supply and the marvelous POWERIZER tone to any Atwater Kent set. Except for simple electrical differences, this model is very much like the one above.

List without tubes. $60.00
With UX280 and UX210 .... 74.00

There are four other POWERIZER models. PXY-1 gives the famous POWERIZER tone and ABC supply. PXY-2 gives ABC supply and two stages of audio amplification. PX-2 is a socket power two stage Power Amplifier with ABC supply for its own tubes. P-1 is the still popular POWERIZER of a season ago.

JOBBERS AND DEALERS:

Write us TODAY for folder 1009-PR, "Real ABC Socket Power with Real Tone." It contains much information that will make money for YOU this season.

Licensed by Radio Corporation of America
and Associated Companies

RADIO RECEPTOR CO., Inc.
106 Seventh Avenue New York City

LIKE A LONG ARM!

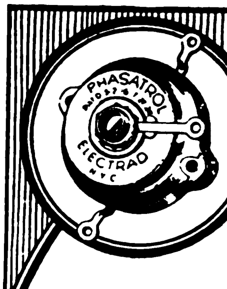
Tune out a poor program and bring in a good one—without leaving your easy chair. Only tuning unit of its kind.

Easily attached to any single dial receiver with removable dial by removing old dial and attaching Remote Control adapter plate.

Mechanical Model $18.00
Electrical Model $60.00

Write for illustrated descriptive circular

Algonquin Electric Co.
245 Fifth Avenue, New York City



Licensed by Rider Radio Corporation.
Pats. Pending.
Patented 5-2-'16.
Patented 7-27-'26.

Like Magic!

"Phasatrols"

Reg. U. S. Pat. Office

A true balancing device for Radio frequency amplifiers

Price - - $2.75

You can't enjoy your radio if you continually hear oscillation noises and squeals. Install Phasatrols—they end oscillations just like magic.

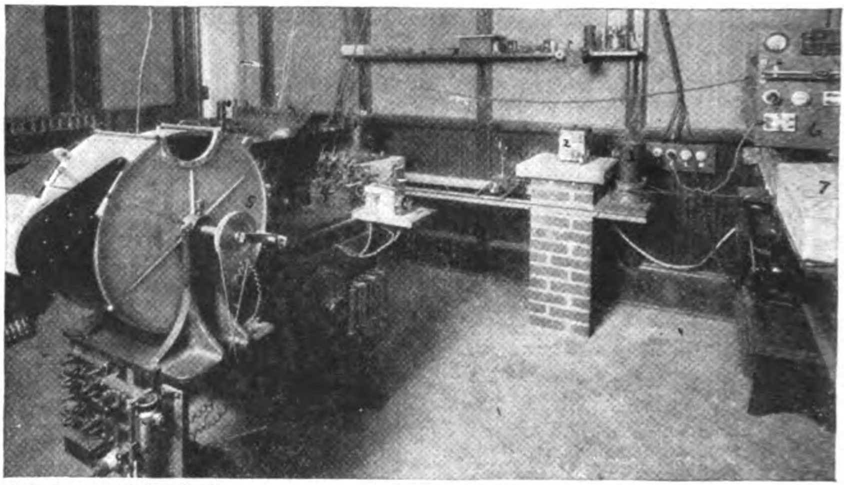
This marvelous device not only checks oscillations, but it eliminates distortion and interference to nearby sets as well.

Install Phasatrols yourself—it's easy. Ask your dealer today.

Write for free hook-up circular for any set or circuit.

Dept. 58A, 175 Varick Street
New York, N. Y.

ELECTRAD
Inc.



U. S. Bureau of Standards

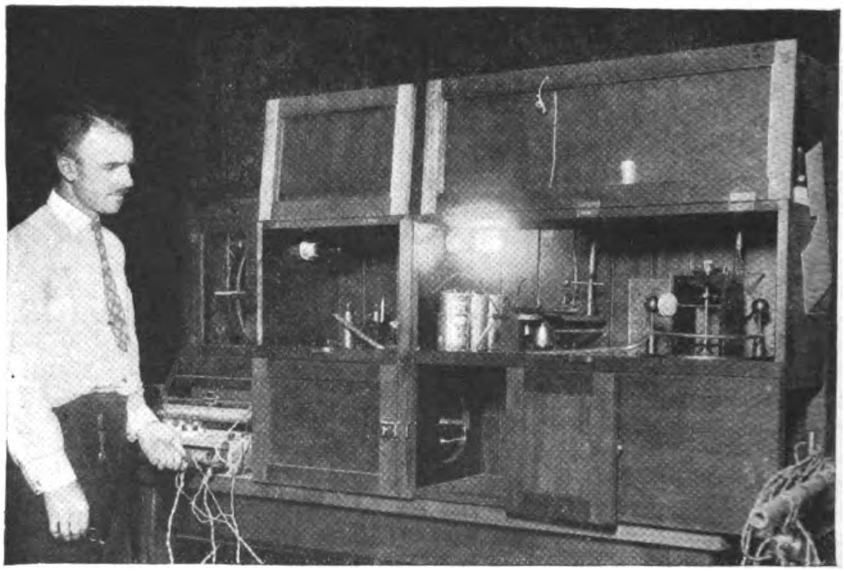
WHERE THE PENDULUM TIMES THE TUNING FORK

The fundamental standard of audio-frequency provided by the new work at the Bureau of Standards is a short pendulum which swings inside a vacuum in the small case resting on the brick pillar and marked 2 in the photograph. At the right of this is the case, marked 3, containing the photoelectric cell. The figure 4 indicates the oscillograph by which the records of fork and pendulum are combined, and 5 marks the camera which photographs the joint record.

Taming the Tuning Fork

ALTHOUGH several standards of audio-frequency are available, the most convenient remains the tuning fork. It is interesting to record, therefore, that the Sound Section of the United States Bureau of Standards has perfected a method of comparing the frequencies of tuning forks with that of a swinging pendulum, with an accuracy involving a probable error of less than one part in 40,000. The results are published by Mr. Philip P. Quayle,* of the Bureau, already well known from his work, two years ago, in photographing the flight of bullets.

A freely swinging pendulum, like the pendulum of a clock, is probably, as Mr. Quayle remarks, "the most accurate timekeeper known at present." With proper precautions as to swinging in vacuum, the elimination of outside forces and vibrations, and so on, such pendulums are used not only for the precise clocks of the astronomical observatories, but for the determination of gravity and for many other physical and chronological purposes. Ordinary pendulums swing, however, in a period of from one second to a fifth of a second, or only a little less. The comparison of these relatively slow vibrations with the two hundred or three



Underwood

WHERE FLYING BULLETS HAD THEIR PICTURES TAKEN

Mr. Philip P. Quayle, who recently perfected the Bureau of Standards' method of comparing the vibrations of a tuning fork with the swings of a pendulum, attracted attention some months ago by photographing bullets shot from a gun. This photograph shows him with the camera which accomplished this remarkable feat.

---

* "A Note on the Measurement of Small Time Intervals," by Philip P. Quayle. *Journal of the Franklin Institute* (Philadelphia, Penna), volume 203, pages 407-412 (March, 1927). POPULAR RADIO is indebted to Director George K. Burgess, of the Bureau of Standards, for further information concerning Mr. Quayle's investigations, as well as for one of the photographs reproduced herewith.

hundred vibrations a second of the usual tuning fork offers great difficulties. Tuning forks are used, in turn, to standardize other rapidly vibrating systems, like musical instruments or low-frequency oscillators. That is why it is so desirable to have a precise way of comparing the rate of a tuning fork with the slower, but more dependable, pendulum.

This is what Mr. Quayle and his associates in the Bureau of Standards have accomplished. A standard pendulum, of the type used by the United States Coast and Geodetic Survey for the determination of gravity, was allowed to swing back and forth between a source of light and a sensitive photoelectric cell of the potassium-hydrogen type manufactured by the General Electric Company. Each interruption thus created in the light beam produced a stoppage of the electric current through the photoelectric cell. This electric effect, after amplification by vacuum-tube amplifiers, was impressed on the record of an oscillograph, which was also recording the vibrations of the tuning fork. This photographed on the same film a record of the pendulum strokes and a record of the vibrations of the fork.

Thus the number of fork vibrations between each two swings of the pendulum could be determined with a high degree of accuracy, providing what is probably the most accurate, as it is certainly the most direct, method of comparing them.

An Innovation in Vacuum Valve Construction

ONE of the few real innovations in the fundamental design of vacuum tubes is mentioned in a recent issue of the English scientific periodical, *Nature.** This is the reported use, by the British Navy Department, called the "Admiralty," of transmitting vacuum tubes the bulbs of which are made of fused silica instead of glass.

Silica is another name for that same quartz or rock crystal which is now so much used to make mercury arc lamps and other devices for producing ultra-violet light. Silica is transparent to these rays, as well as to heat rays, and possesses the other property valuable for use in vacuum tubes, that it can be highly heated without fusing or cracking, as glass does. A silica vacuum tube for high-power transmitting duty may be operated, therefore, at a much higher temperature than is possible for one with a glass bulb. Blasts of cold air, or even of water, may be directed against the outside of the hot silica, for cooling purposes, without danger of a crack. The transparency of the material for heat rays also assists cooling.

At a meeting of the Institution of

---

*In a news note on page 757 of the issue for May 21, 1927, volume 119.

S.M. UNIPACKS

NEW SAMSON POWER PACK

NEW! LC-28 Complete Parts in stock!

WRS sells the parts exactly as specified by the designers of the circuits. We make no substitutions. Every part in our LC-28 KIT is exactly as used by Mr. Cockaday in his laboratory model.

We have built up a national reputation through our service on kits and special apparatus. By purchasing your kits from WRS you not only assure yourself of the correct discount but save many dollars through delays in obtaining the parts from a dozen different jobbers.

Be sure to write for our new catalog and discount sheet listing the newest and latest circuits, sets and accessories.

WRS is exclusive distributor for the Aluminum Panels for LC-28 circuit. Dealers and Jobbers — Write for proposition.

Wholesale Radio Service Co.
6 Church Street, New York City

KARAS EQUAMATIC

PACENT PHONOVOX

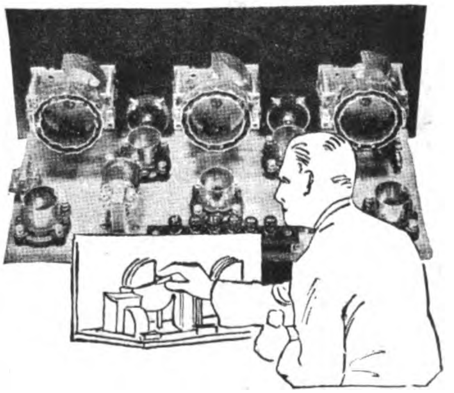
BREMER TULLY COUNTERPHASE SIX

LOFTIN WHITE

NEW! REMLER INFRA-DYNE

Hammarlund ROBERTS HiQ

$75 A WEEK BUILDING RADIO SETS —*in your spare time*



JOIN the Radio Association of America. Learn how to build and repair radio sets. The Association will train you—start you out in business if you wish. Be the radio "doctor" of your community. $3 an hour upwards easily made. Radio offers you a big money-making opportunity right now.

Earns $500 in Spare Hours

"I have at last found myself," writes Lyle Follick, Lansing, Michigan. "I have already made over $500 building radio sets after working hours." Werner Eichler, Rochester, N. Y., writes, "I have made over $50 a week in my spare time."

Our members are starting radio stores, increasing their salaries, securing better positions, earning big money for the most enjoyable kind of spare-time work.

What a Membership Means

A membership in the Radio Association of America gives you the most up-to-date and thorough training in the Science of Radio.

You're taught how to build and repair all kinds of sets. You receive the privilege of buying parts at wholesale prices.

You're helped to make money.

Join the Association Now

If you're interested in Radio for either pleasure or profit, join the Association without delay, because we have a plan whereby your membership may not—need not—cost you a cent. Only a limited number of these memberships are acceptable. Write now for details. Write before it's too late.

This Association has prepared a beautiful book that gives figure-facts regarding the profit possibilities of the Radio Industry, the purpose of the Association, and the details of the Special Membership Plan.

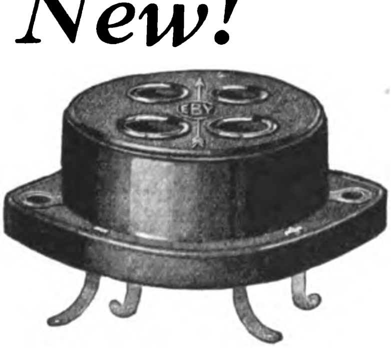
Mail This Coupon

RADIO ASSOCIATION OF AMERICA
Dept. PR-9---4513 Ravenswood Ave., Chicago

Send me your book and details of your Special Membership Plan.

Name.......................................
Address.....................................
City..........................State...........

New!



and *Much* Better

The prongs are completely enclosed and *can't* spread. No more socket trouble to shoot!

After all, a socket's only job is to provide a perfect contact. The Eby three-point wiping spring contact is the most scientifically perfect type known.

Easy to mount above or below Bakelite, Wood or Metal.

Specified in numerous popular circuits. List Price 40c

THE H. H. EBY MFG. CO.
INCORPORATED
4710 Stenton Ave.
Phila., Pa.

Makers of Eby Binding Posts

QUALITY DONGAN PRODUCTS

Power Transformers and Chokes —insist on Dongan

It's a "power year." Whatever type of A. C. or Rectifier Tube you select for power unit operation insist on Dongan Transformers and Chokes.

Write for full information on transformers for new A. C. Filament Tubes.

Power Transformer No. 3591

Used with 350-400 m. a. rectifier tubes, making a thoroughly satisfactory and practical A B C eliminator. Specify make of tube you will use.

$15 List

Choke No. 3584

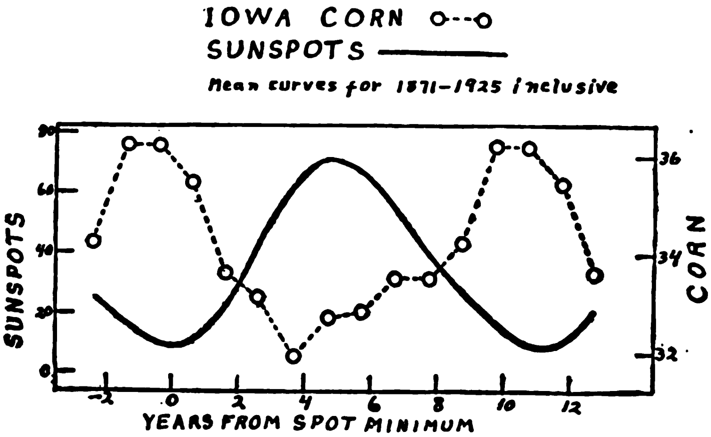
Used together with above transformer and 350-400 m. a. rectifier tubes.

$15 List

If your dealer cannot supply you send check or money order to factory direct

DONGAN ELECTRIC
MANUFACTURING COMPANY
2983-3001 Franklyn St. Detroit, Mich.

TRANSFORMERS of MERIT for FIFTEEN YEARS



From *Popular Astronomy*

THIS CURVE CAN SERVE FOR STATIC AS WELL AS CROPS

Records analyzed by Professor C. C. Wylie, of the University of Iowa, show how the yield of corn from Iowa farms varies with the number of sunspots visible on the sun. When there are many sunspots, the crop is poor; when there are few, it is good. The dotted line, instead of indicating the corn crop, might be used, equally well, to indicate the quality of radio transmission, for static increases with the sunspots as the corn crop decreases.

Electrical Engineers in London on May 4, 1927, Messrs. H. Morris-Airey, G. Shearing and H. G. Hughes are reported to have described a series of these new high-temperature tubes constructed in this way, as well as a method of sealing in the electric connections with metallic lead, applied to the silica as a molten liquid and allowed to cool —almost a soldering method.

The Effect of Static on the Corn Crop

THE influence of sunspots on static is well established; for the internal condition of the sun that produces the spots also disturbs earthly weather and increases the number of the atmospheric electric sparks and lightning flashes which so annoy the radio listener. Sunspots are being blamed nowadays for almost everything else, from epidemics to wars; apparently not because there is any real evidence connecting them with such catastrophes, but merely because *something* must be held responsible and the sunspots are visible and undefended.

Amid this haze of loose statement it is important to distinguish, as the real facts come to light, any earthly circumstance with which the solar conditions seem to have indubitable connection. One of these, as might be expected, is the weather.

A new instance is the relation, recently unraveled by Professor Charles Clayton Wylie, of the University of Iowa, and his students, between the sunspot cycle and the yield of corn on an average acre of Iowa farm land.*

During the thirty-three years between 1892 and 1924, the years of minimum sunspots are clearly marked as years of unusually good yields of corn. Conversely, the high parts of the sunspot curve are times when the corn crops have averaged poor or below normal. The relation is due, Professor Wylie feels, to a temperature effect. Comparison of the weather records shows, he reports, that years of many sunspots tend to be years of average low temperature. In years of few spots the summer temperatures are somewhat higher; the corn grows better and crops are larger. Although crops and static lack the direct relation of effect and cause, it is probably safe to say that the summers in which the Iowa farmer finds his radio set staticly afflicted are apt to be also the summers in which his annoyance will be increased by a shortage in the yields of his cornfields.

---

* "The Solar Cycle in Temperature and in Crops," by Charles Clayton Wylie. *Popular Astronomy* (Northfield, Minn.), volume 35, pages 253-256 (May, 1927).

An Amplifier of Unique Design

A constructional article on an amplifier that embodies the ideas of Manfred von Ardenne, the youthful German expert on low-frequency amplification, will be a feature of the October number of POPULAR RADIO. *Resistance-coupled amplification is employed in a way that gives an amplification equal to transformer coupling. In addition, the amplifier is one of the most compact units of its kind ever designed.*

NOW— Everyone Interested in Radio

will find a wealth of surprising bargains in the best radio parts and accessories

in this NEW HAMPTON-WRIGHT RADIO CATALOG FOR 1927 AND 1928

JUST off the press, and crowded with the well-known products of the world's greatest radio equipment manufacturers, the new number of the 1927-28 Hampton-Wright Radio Catalog offers hundreds of unexcelled bargains to every person in the United States interested in radio.

In this new and enlarged catalog, radio values are offered which you cannot afford to overlook—whether you are a dealer, a professional set-builder, or an enthusiastic fan.

Send for this new "Book of a Thousand Radio Bargains," and see why our growing thousands of customers are making Hampton-Wright's size and reputation outstanding in the radio world.

This is going to be our greatest year—take advantage of it!

HAMPTON-WRIGHT
Darmody Building
Indianapolis Indiana
"Keeping Pace With Radio"

Hampton-Wright,
138 Darmody Bldg.,
Indianapolis, Ind.

Dear Sirs: Please send me your new radio catalog, full of bargains in parts and accessories.

Name..............................

Street..............................

City..............................

State..............................

NEW DONLE TUBES

With Low Temperature Filaments

H. P. Donle has developed a line of tubes as revolutionary as his "Sodion" contribution.

The outstanding characteristics of these tubes are:

Burn with an almost black filament
Possess high emissivity
Not sensitive to gas
Practically non-microphonic

B8—Detector Tube..*List Price $4.00*

This tube is superior in sensitivity to any of the alkali metal group or other "super-sensitive" tubes, and is free from "hiss" or extraneous noises.

DP 71—Power Tube (180 volt plate current)........................*List Price $4.50*

This tube is far superior to any tube that has yet appeared, in the amount of current delivered to the loudspeaker with a given applied signal strength.

DR 4—Full Wave Rectifier Tube........................*List Price $4.50*

DP 10—Power Tube (450 volt plate current)........................*List Price $6.00*

Both these tubes will give longer life and greater efficiency, due to the high emissivity at low temperature.

Warford Electric, Inc. 42 Whitehall Street New York

Short-Wave Radio for the Treatment of Disease

ONE of the most remarkable scientific developments of recent months is the enormous increase in the use of radiations of one kind or another in the treatment of disease. The ultraviolet ray, well known to readers of the Department as merely a variety of light wave slightly shorter in wavelength than the visible kinds of light, is now an all but universal tool in hospitals and sanitaria.

Almost as much use is being made of the infra-red rays—light rays which are longer than the waves of visible light, just as the ultraviolet rays are shorter. The latest development, still experimental but interesting, is the use of very short radio waves, approximately eight-tenths of a meter in wavelength, on patients suffering from disease.

The experiments with these waves are being conducted at the Institute of Actinology, in Paris, where the Director of that Institute, Dr. Jean Saidman, has installed many kinds of apparatus for the production and test of different varieties of radiation.* The eighty-centimeter radio waves are produced by a small vacuum-tube oscillator not essentially unlike the well-known short-wave oscillators used by radio experts both in France and in America. The output of this oscillator is discharged from a small loop of heavy copper tubing and may be focused on the patient by a suitable reflecting mirror. If desired, the radio energy may be concentrated on a single part of the patient's body, such as an arm or a leg, by surrounding that member with a coil of wire or of copper tubing like that used on the oscillator itself.

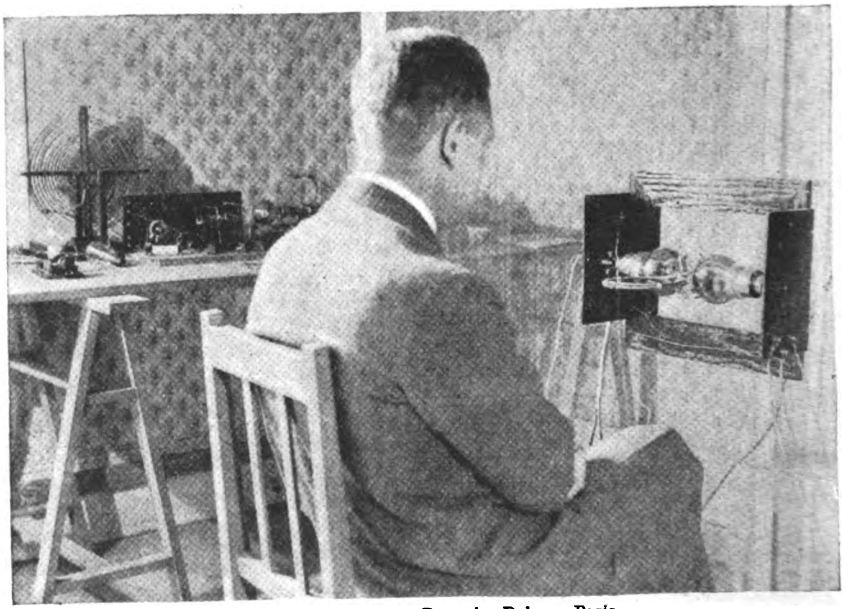
From the information now at hand, it is not apparent how the new procedure differs in physiological essentials from the so-called "diathermy" processes, in which electric currents of high frequency, not much less than those corresponding to the eighty-centimeter waves, are fed into a selected portion of the body. Whether or not these high-frequency currents have special electric effects is unknown, but they certainly have heating effects. It is to this local heating of the affected tissues that most of the physicians who are experimenting in this field of endeavor ascribe the benefits obtained.

In the standard diathermy methods the electric waves are applied as currents, not as radiation. Furthermore, the electric frequencies employed are by no means pure, often including waves of many different frequencies mixed together. It is conceivable that a pure, eighty-centimeter wave, applied as radiation rather than as actual electric current, may have unexpected physiological effects. It is excellent that the matter is to be tried.

In this entire field of the effects of radiations on the human body there is a dearth of information about pure radiations. The so-called ultraviolet rays which physicians use are not pure rays of this variety, but consist of varying amounts of the ultraviolet radiation mixed with much larger amounts of vis-

---

* Information from the Delano Service, Paris. The equipment and work of the Institute of Actinology are described briefly in the *British Journal of Actinotherapy* (London), May, 1927, page 31.



From a photograph made especially for POPULAR RADIO by Delano, Paris

TESTING CURATIVE POWERS OF SHORT RADIO WAVES

This short-wave oscillator, discharging waves approximately eighty centimeters long, will be used by Dr. Jean Saidman, of Paris, to test the possible effects of these waves on sick persons and on the human body generally. The radiation is emitted by the horizontal loop of copper tubing in front of the vacuum tube. Metal wires behind the wooden frame reflect the waves toward the patient, seated in front of the oscillator loop.

6 TUBE RADIO
ONE DIAL
Only $32⁵⁰

Latest advanced circuit. All-steel chassis, totally shielded. Balanced parts of best quality. Marvelous power and selectivity. Gets the long-range stations as clear as a bell. One-dial single control. Encased in cabinet of fine finish and rare beauty. Here is a value unsurpassed in the realm of radio—just one of the mighty bargains listed in my new catalog. Get full details before you buy any radio. An unsurpassed value—just one of our many mighty bargains.

FREE Catalog, Log and Call Book

It's just off the press! Chock-full of radio's latest and best 1928 developments. 132 pages of real radio information. Lists all the latest receivers, eliminators, chargers, speakers, kits, parts, etc. All the radio stations and newly assigned wave lengths. A regular encyclopedia of Radio information. And it's Free! Send for your copy today.

AMERICAN RADIO BARGAINS

AMERICAN AUTO & RADIO MFG. CO.
Harry Schwartzberg, *Pres.*
Dept. 202, American Radio Bldg., Kansas City, Mo.

for power circuits

It has become standard practice to use

Parvolt Wound Condensers

in circuits which quickly break down ordinary by-pass or filter condensers.

You will find that the same characteristics of accuracy, high direct current resistance, and the ability to give continuous duty at full rated voltage, make them desirable in circuits where even a poor condenser might "get by."

ACME PARVOLT CONDENSER 1 MFD SERIES B 800 volts D.C. SANGAMO MADE IN U.S.A.

THE ACME WIRE COMPANY, NEW HAVEN, CONNECTICUT
PARVOLT
WOUND CONDENSERS
6131-4

ible light. The infra-red rays are similarly impure. Scientific precision has seldom been attained, either in clinical treatment or in laboratory experimentation. It is extremely probable that observed effects ascribed to one kind of radiation may be due, in fact, to other kinds that were also present. It is as though the physicians endeavored to discover the effects of some new drug by mixing together all of the drugs from one shelf in the drug-store and guessing at which one of them was to be held responsible for the effects of the mixture.

Perhaps the most dangerous feature of this situation is that it has opened a door for quackery. When orthodox physicians do not really know what kind of ray is producing the curative effects that they observe, there is room for unscrupulous quacks to claim impressive knowledge which they do not possess. That is one danger to be guarded against in public mention of the use of the new eighty-centimeter waves by Dr. Saidman. This is an experimental use, admirable because it attempts, for the first time, to see what the physiological effects of a reasonably pure electric radiation really are. It emphatically is not something to be copied by the quack who knows neither radio nor physiology, merely because such words as radio now impress the ignorant or because the short-wave oscillators which produce these eighty-centimeter waves are spectacular bits of machinery in the stage-dressing of quackery.

To his experiments on the real function of these one-frequency short radio waves Dr. Saidman proposes to add experiments on pure radiations in the ultraviolet, infra-red and visible fields. To produce these pure radiations of any selected wavelength, he has constructed what is said to be the largest spectroscope in the world. Its prisms are nearly ten inches in face and will produce a spectrum of visible and invisible rays enormously more powerful than is possible with ordinary spectroscopes. Glass prisms cannot be used, as glass is opaque to many of the rays which it is desired to test, including the ultraviolet ones. Dr. Saidman's prisms are made of quartz plates, but are hollow, the interior being filled with water. It would be better to use large prisms of solid quartz or rock crystal, this material being fully transparent to all of the rays involved. Dr. Saidman believes such large, solid prisms of quartz to be unobtainable, but this is no longer the case. Thanks to some recent technological developments in America, a spectroscope with solid prisms almost as large as Dr. Saidman's hollow ones is now under construction. Popular Radio hopes soon to be able to report further details of progress in this branch of electrical science.

Still the Standard of Excellence in Audio Transformers

The AmerTran DeLuxe
for 1st and 2nd Stages $10.00 each

MONTH after month speeds the development of new radio units. Yet today the AmerTran DeLuxe is still the measure used to judge transformer quality. Time has only broadened its acceptance as *the* faithful amplifier of natural quality.

Research and test laboratories—some of the best known in the country—use the AmerTran DeLuxe, as it comes nearest in their opinion to perfection in this type of apparatus. Structural ruggedness has made the AmerTran DeLuxe stand up in the climate of Central America. It has proved itself under all conditions. With the proper tubes and loudspeaker, and clear signals from the detector tube, these transformers will produce the truest quality with most volume.

Write for information on building power, supply devices and booklet, "Improving the Audio Amplifier."

AMERICAN TRANSFORMER CO.
178 EMMET STREET NEWARK, N. J.

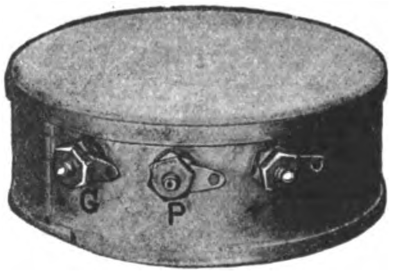
"Transformer Builders for Over 26 Years"

Other AmerTran Radio Products:

Type PF52 Power Transformer
Type PF281 Power Transformer for filament plate supply with new tubes
Type H-67 Filament Heating Transformer
AmerTran Resistor Type 400
AmerChokes Types 854, 709 and 418

Standard parts and equipment at money-saving prices, with discounts that show you a real profit. Electrical Phonograph—pick-ups—latest kits! New A C tubes and transformers—parts for any circuit—power audio equipment—short-wave supplies—they are all in our big new 1928 Catalogue. Write for it today, with discount sheet. 12-hour shipment guaranteed.

Dan-Ashe Radio Co.
204 North 10th ST. ST. LOUIS, MO.



Shielded Tuned Radio Transformer, No. 30

SICKLES

Diamond-Weave Coils

The new Sickles Shielded Tuned Radio Transformer prevents both outside and local interference. It is remarkably compact, sharp-tuning, sturdy.

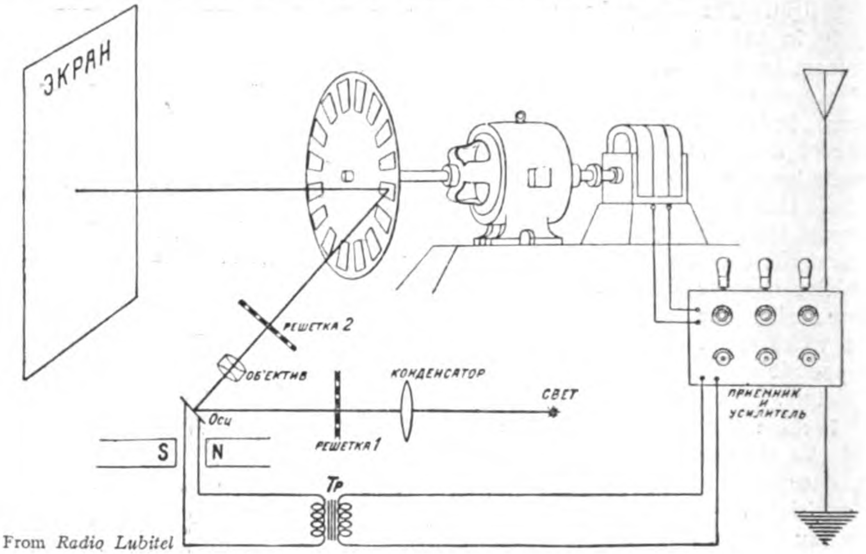
Sickles Diamond-Weave Coils have established an enviable reputation for low distributed capacity, low dielectric losses, and large range of frequency with small variable capacity.

The ideal coil for the Na-Ald Localized Control Tuning Unit and the Na-Ald Truphonic Assembly.

There are Sickles Diamond-Weave Coils for all leading circuits.

THE F. W. SICKLES CO.
134 UNION STREET
SPRINGFIELD :: MASS.

No.	Coil Prices	
30	Shielded Transformer	$2.00 each
24	Browning-Drake	7.50 set
18A	Roberts Circuit	8.00 set
25	Aristocrat Circuit	8.00 set



From *Radio Lubitel*

A DIAGRAMMATIC VIEW OF THE RECEIVING END OF TERMEN'S TELEVISOR

The radio receiver is at the right, its impulses acting to tilt the small, moving-coil mirror in the lower left-hand corner of the diagram. The percentage of the light ray which passes the two screens is determined by the angle of tilt of the mirror. The numerous small mirrors mounted on the revolving disk then reflect the varying light intensities onto the screen at the left to make the units of the scene. The motor runs synchronously, with a similar motor at the transmitter carrying a similar mirror-studded disk.

A New Russian "Televisor" Enters the Field

ONE of the limitations of the Telephone Company's process of television, reviewed elsewhere in this Department this month, is that it is not suitable, at present, for viewing scenes illuminated by ordinary diffuse light. One cannot look out of a distant window by the Ives-Gray televisor. Instead, the scene to be transmitted is limited to near-by objects, like the face of a sitter, which objects can be illuminated largely, if not exclusively, by the moving spot of light upon which the operation of the process depends. Although this limitation is probably only temporary, there being several conceivable ways of overcoming it, its present existence gives interest to a Russian television process not thus limited and which has been worked out in one of the Soviet scientific institutions.

This Russian process, the invention of Mr. L. C. Termen, of the Physical-Technical Institute at Leningrad (St. Petersburg), Russia, divides the scenes to be viewed into units by means of small mirrors mounted on a revolving disk, obtaining its light from the general illumination of the object being viewed.* It compares, therefore, with the processes of Baird and Jenkins, which also make use of the general illumination of the scene, either from mere daylight or after artificial augmentation with lamps. Baird obtains the division of the scene into units by a series of viewing cells which permit the sensitive photoelectric cell to "see" only one unit at a time.† Jenkins uses, instead, a system of rotating, prismatic lenses which split up the scene optically.§ Ives and Gray use the moving spot of illumination. Doubtless still other ways are possible and probably many will be tried.

Aside from the use of small reflecting mirrors to obtain the necessary units of view for transmission, the Termen process follows lines which are now almost conventional. The varying light from the mirrors is converted into an electric signal by a photoelectric cell, amplified, transmitted by wire or radio and received by a standard receiver.

The reconversion of the electric signal into the visual scene is not accomplished, as in the other processes mentioned, by a lamp varying in intensity, but by a moving mirror which increases or decreases the portion of a light ray passing through two systems of slats, like Venetian blinds. This device also is not new, having been used in some of the early experiments in talking over beams of light.

There seems no present reason to expect that the Termen system will excel the Ives-Gray one, but its idea of the unit-forming reflecting mirrors may be worth further attention.

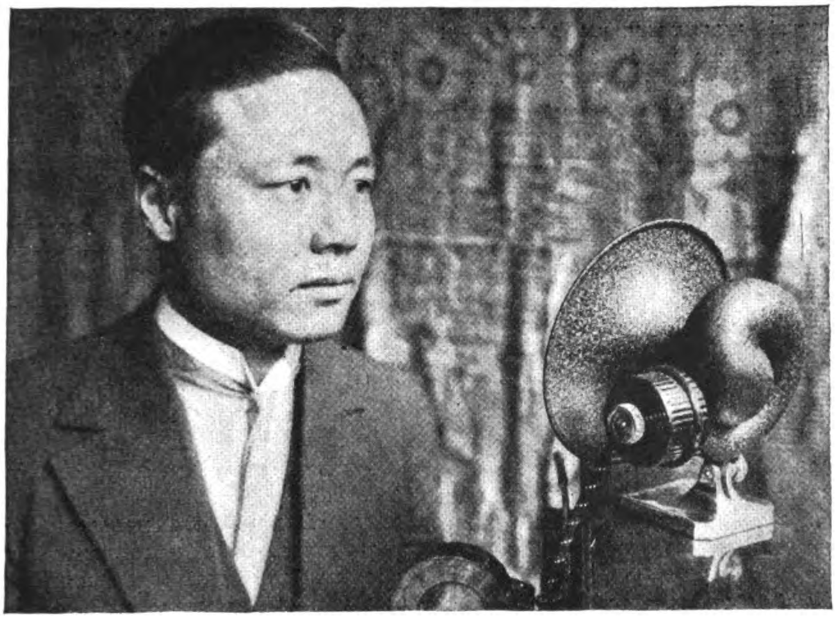
Of course, any experimentation along the lines of this new development is a help and may uncover some important details that would have far reaching effects on the final outcome.

---

* "Television: Transmitting Moving Pictures by the Process of L. C. Termen" (in Russian), by V. Ginsburg and V. Pulver. *Radio-Lubitel* (Radio-Amateur) (Moscow), volume 4, pages 13-16 (issue number one for 1927, not otherwise dated).

† "The Latest Experiments with Television and 'Black Light,'" by John L. Baird. POPULAR RADIO for May, 1927, pages 447-451, 498.

§ "The New Radio Movies," by Watson Davis. POPULAR RADIO for December, 1923, pages 437-443. "Radio Transmits Weather Maps to Ships," by S. C. Hooper. POPULAR RADIO for November, 1926, pages 655, 698.



Delano, Paris

A CONTORTIONIST AMONG HORNS

This young Chinese inventor, Lu Feng Chai, now residing in Paris, has constructed an unusual loudspeaker horn, in which space is economized without reducing the length of the horn. In spite of its many bends, the horn enlarges gradually from the inner end to the outlet, in approximate correspondence with the exponential principle explained elsewhere in this issue of POPULAR RADIO.

Home-Made Loudspeakers

THE manufacture of one's own loudspeaker is not an exercise to be recommended to the average radio listener who desires merely to hear the entertainment that broadcasting provides; it is easier, and usually cheaper, to buy some one of the many admirable instruments which radio manufacturers have perfected. There are far lighter tasks than that of avoiding the many pitfalls, electric and acoustic, which beset the hopeful amateur in this field. For the experienced constructor, however, there are interesting problems in designing and building exactly the kinds of loudspeaker needed for this or that special purpose. The experience will be both amusing and profitable, even if the result is merely amusing. To those who wish to try their hands in this field there is to be recommended a pair of recent articles by Professor N. W. McLachlan, a well-known English physicist.* The principles which control the design and construction of the new type of moving-coil instrument are well described.

A New Direct-Current Transformer

THE principle of the transformer, by which a current of one voltage can be changed to one of higher or lower voltage, is usually assumed to be applicable only to alternating currents. Certainly the passage of a direct current through one of the two familiar coils of the electromagnetic transformer produces far from the desired effect.

There exist, however, several theoretical ways in which a direct-current transformer might be built. The old-fashioned static machines which physicians used to keep in their offices and which high school teachers still use sometimes to illustrate the properties of static electricity, may be considered as direct-current voltage-raisers of a kind.

A principle somewhat similar, in theory, to these has been used by Mr. Preston B. Carwile, of the University of Virginia, in a recent device capable of producing a potential of over 1,600 volts from the usual source at approximately 110 volts.*

The idea is to take a series of condensers, connect these in parallel to the low-voltage source, then connect these same condensers in series for discharge.

In Mr. Carwile's device a rotating commutator so manipulates the connections of four condensers that this principle receives still further increments, resulting in the increase of voltage mentioned. No large amount of current can be delivered and the details of uniform operation must still be studied. It seems conceivable, however, that some such device might be useful to produce relatively high potentials from which the current draft is to be slight.

That the device might be utilized in radio operation is a contingency that is at present very remote, but Mr. Carwile's idea is practical enough to be watched with interest.

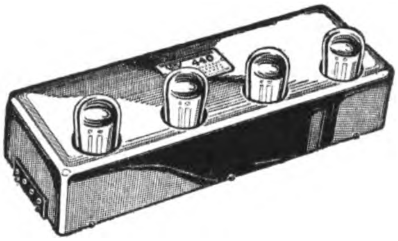
---

* "Coil-Driven Diaphragm Loud-Speaker Design," by N. W. McLachlan. *The Wireless World* (London), volume 20, pages 372-377 (March 30, 1927), and pages 440-446 (April 13, 1927). See also "How to Build the New Exponential Horn," in this issue of POPULAR RADIO.

* "A Direct Current Potential Transformer," by Preston B. Carwile. *Journal of the Optical Society of America* (Manesha, Wis.), volume 14, pages 323-327 (April, 1927).

SM

The Best!



The 440 Time Signal Amplifier is a fully assembled three-stage, 112-K. C., long-wave amplifier—detector catacomb. It consists of three air-core low-resistance tuned R. F. stages and detector, with all necessary by-pass condensers, etc., mounted in a copper-and-brass catacomb, providing individual stage and over-all shielding.

Each 440 amplifier is accurately matched in the S-M laboratories to exactly 112 K. C., and every amplifier is guaranteed to within one-half of one per cent. The selectivity of the 440 is tremendous—it may be made 10 K. C., or even 5 K. C. at will, while the sensitivity is guaranteed greater than that of any amplifier that might be built of individual parts. Price $35.00.

The fall season finds S-M 220 audio and 221 output transformers still the acknowledged leaders in the high-quality transformer field. And they are accorded the sincerest form of flattery—imitation—for this year other manufacturers, profiting by S-M transformers' phenomenal success, copy the 220 characteristics introduced by S-M a year ago—5,000 cycle cut-off, rising low-frequency characteristics, and plenty of iron and copper to make a 100% job. But S-M audio transformers stand supreme as the finest available—the only types ever backed by a guarantee of BETTER reproduction or your money back. That's the S-M guarantee—and the return average is less than one in every 4,000 sold—3,999 satisfied customers out of every 4,000. 220 Audio Transformer, price $8.00. 221 Output Transformer, $7.50.

SILVER-MARSHALL, Inc.

844 WEST JACKSON BLVD.

CHICAGO, U. S. A.

YOUR RADIO PROBLEMS SOLVED

POPULAR RADIO maintains for the benefit of its readers a Technical Service Bureau and Laboratory, which will, without charge, answer by personal letter any question or problem submitted by a subscriber.

In writing please confine your questions to one general subject, writing on one side of the paper only, and enclose a self-addressed and stamped envelope.

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently: look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c. a copy.

May, 1926
—How to Draw Up Your Own "Tuning Graphs."
—How to Build the Improved Raytheon Power-pack.
—How to Build an Antenna Mast for $15.00.
—Fifteen Ways to Reduce Static.
—Do Your Coils Broadcast?

June, 1926
—How to Build the New Home Receiver.
—How to Put Up a Good Outdoor Antenna.
—How to Get the Most Out of Your Ready-made Receiver.
—Audio-frequency Amplification. How to Get it Without Distortion.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.

July, 1926
—How to Get the Best Reception in Summer.
—The Best Crystal Set for $13.00.
—How to Build the Newest Portable "Town and Country" Receiver.
—Four New Combinations of Units for Assembling the Raytheon Power-pack.
—How to Get the Most Out of Your S-C Receiver.

August, 1926
—A New Method of Using Harmonics for Determining Frequencies.
—POPULAR RADIO Circuits.
—How to Build the Improved Browning-Drake Receiver.
—How to Pick Out a Loudspeaker.
—How to Get the Most Out of Your "Town and Country" Receiver.
—Three Vacuum Tubes in One.

September, 1926
—Foretelling Radio Reception from the Weather Map.
—How to Build an Impedance-coupled Amplifier.
—A Radiant Crystal Pilot.
—POPULAR RADIO Circuits.
—How to Simplify Your Set with Automatic Filament Controls.
—Inside Information on New Radio Receivers.
—How to Wire Your House for Radio.

October, 1926
—How to Build the New LC-27 Receiver.
—The Radio Road Hog.
—POPULAR RADIO Circuits.
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits.
—How to Build the LC-Intermediate Power-pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC-Junior Power-pack.

February, 1927
—The Coming of the "RADIO UNIVERSITY."
—How to Get Quality Amplification.
—How to Build and Use a Portable Test-Board.
—How to Assemble the All-Amax Senior Three-tube Reflex Receiver.
—What's New in Radio.

March, 1927
—How to Build the Univalve Receiver.
—POPULAR RADIO Circuits.
—How to Increase the Range of Ammeters and Voltmeters.
—How to Build Your Own 36-Inch Cone Loudspeaker.
—What's New in Radio.

POPULAR RADIO
Dept. 48
627 W. 43d St., New York

Advance Information About the New LC-28 Receiver

(*Continued from page 150*)

The third condition that makes many circuits unstable is due to the resistances of the batteries or power-pack used as the plate-circuit voltage supply. If both the plate coils are coupled through the same battery, a varying alternating current from the plate circuit of the second stage, passing through the resistance of the battery, shown at *C*, in Figure 5, causes a voltage drop across the resistance that effects the plate circuit of the first stage, which is coupled to the grid circuit of the second stage, thus causing feed-back, regeneration and ultimately an unstable condition.

In designing the LC-28 the problem was to find a method for eliminating, practically and simply, all of these effects, so that regeneration would not be present in any dangerous quantity. It was decided that if this could be accomplished without using load or loss methods, that the coupling could be increased, as well as the step-up ratios between valves, so that a heretofore unattained amplification might be obtained.

Starting with the problem of electromagnetic feed-back through the resistances of the batteries, shown at C in Figure 5, it was decided to use the shunt plate feed arrangement, shown in Figure 4. In this system, two choke coils, L1 and L2, are inserted in parallel with the plate circuit of each valve. These choke coils pass the direct current through to the plates of the valves, but they eliminate any chance of high-frequency alternating current running down through them to the resistances of the "B" supply, and in this way they also eliminate any feed-back that might otherwise occur at this point.

After a good deal of experimenting, a new type of coil with double secondaries was designed that had practically no external field. During the experiments with this type of coil, it was found that the two secondaries, on account of their uneven coupling to the primaries, had to be wound with a different number of turns in order to produce a true balanced coil with a minimum of external field. The part of the secondary coil wound upon the leg opposite the primary had to have a greater number of turns, due to the greater mutual inductance between the primary and the remaining part of the secondary that was wound on the same leg as the primary. When this was satisfied, both secondary coils had the same number of lines of force threading through them and the field of the coil was then limited to the dimensions of the coil itself. This effect is shown in Figure 9, and in this way the coupling shown at A in Figure 5 was also eliminated. Another precaution,

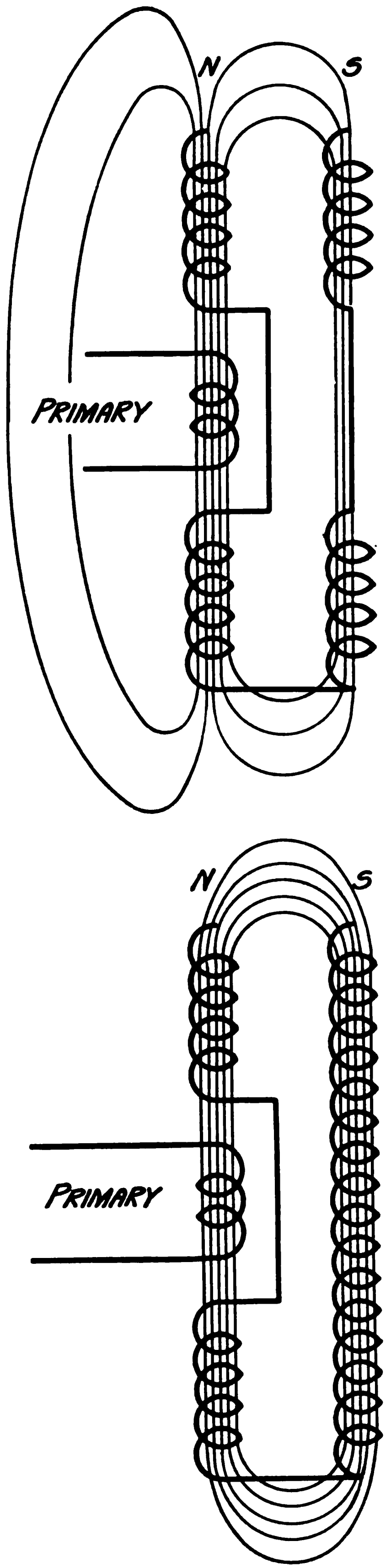


FIGURE 9: *The top drawing shows a symmetrical double-solenoid coil with its large external field. The bottom drawing shows the unsymmetrical solenoid coil used in the LC-28, which is so constructed that it has practically no external field.*

which also helps selectivity, is the shielding of each of the stages, as shown in Figure 4. Notice that the two choke coils are again shielded from their respective stage tuning coils.

The third cause of feed-back—inter-electrode capacity—was reduced by the use of non-inductive, low-capacity resistances inserted in the grid circuit of each high-frequency valve.

These resistances must be of extremely low capacity or they will not be suitable.

In spite of the general opinion that this is a "losser" method, a careful study will reveal that it entails no loss when properly designed and used.

In Figure 6, at the top of the diagram, is shown an alternating current generator with a resistance connected in upper leg of the circuit. If the circuit is left open, as shown, the current flowing through the resistance R will be zero. If the current flowing through it is zero, the voltage drop across it will also be zero, and the output voltage E2 will equal the input voltage E1. This is only true when no load is applied across the output.

Referring to the bottom diagram of this same figure, we see the same principle applied to a vacuum valve circuit. If the resistance R is of large enough value to reduce the current due to the circuit feed-back through the small condenser shown in dotted lines to substantially zero, the drop across the resistance R will be of such low order that the input of voltage, E2, will equal the voltage, E1, across the tuning circuit. In this case the tuning is not broadened, and the circuit is not what is commonly called "a losser."

Having eliminated unwanted regeneration from the circuit, the next job in designing the set was to get the greatest amount of energy output from each valve in the high-frequency stages, and to apply as high a voltage variation as possible to the grid circuit of each following valve.

As stated before, the shunt-plate-feed system is employed. In this system it is necessary to use so-called "blocking" condensers, shown at C in Figure 7, in series with the primary coil shown at P.

Notice that the low end of the primary coil P is connected directly to the filament circuit of the preceding valve, thus giving perfect "by-passing" to the circuit from the primary coil back to the filament of the valve with which it is used.

An alternating current voltage of high frequency induced from the preceding stage is indicated at E1. This voltage variation represents the total power output of which the valve is capable. The high impedance of the choke coil L resists alternating current flow, and practically no current can flow through the "B" batteries or a

It isn't a Question of DX-ing any more—Quality of Tone *is the thing*

MOST listeners-in want crystal clear, undistorted tones more than distance.

They seem to want to set their dials for a desired program and get it right—to get it full, strong, and free from the annoyance of blurring and what might be termed "warped" tones.

The one big thing that the Carborundum Stabilizing Detector Unit does in any set is to improve the tone quality. Besides you will find that it increases the volume and gives you greater distance—if you want it.

The Carborundum Stabilizing Detector Unit

Reg. U.S. Pat. Off.

CLARIFIES RECEPTION

$3.50 IN U.S.A. [WITHOUT DRY CELL]

So will Carborundum Grid Leaks and Resistors

Send for Hook-Up Book D-5

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

SALES OFFICES AND WAREHOUSES IN

New York, Chicago, Boston, Philadelphia, Cleveland, Detroit
Cincinnati, Pittsburgh, Milwaukee, Grand Rapids
The Carborundum Company, Ltd., Manchester, Eng.

The Carborundum Company
Niagara Falls, N.Y.

Please send free Hook-Up Book D-5

Name____________

Street____________

City____________

State____________

Complete A. C. Operation a Practical Reality

For the past several seasons the trend has been toward complete battery elimination. Many satisfactory plate supply units operating from A. C. have been developed, but filament operation from an A. C. source has presented more of a problem due to the larger currents required and increased expense in the rectifier and filter circuit.

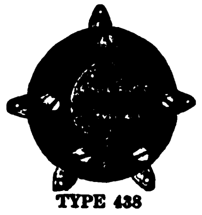
The newly announced A. C. tubes offer an excellent solution to this problem.

TYPE 440-A

TYPE 440-A LOW VOLTAGE TRANSFORMER

The Type 440-A Transformer supplies voltages for all popular A. C. tubes and sufficient current for all ordinary receiver requirements. The following voltages and currents are available: Pri. 115 V (for lines 105-125) 60 cycles.

Sec. 2 volts........8 amperes
3.5 volts........2 amperes
5 volts........2.5 amperes
7.5 volts........2 amperes
Price........$10.00



TYPE 438

TYPE 438 SOCKET

The new type UY-227 or CX-327 detector tube has a separate heating element and requires a socket designed to take the new five prong base.

Type 438 Socket........$0.50

TYPE 439 RESISTANCE

The new A. C. tubes require a resistance with center-tap across the filament. The Type 439 resistance is adaptable to any type of socket.

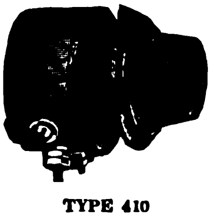
Type 439 Center Tap Resistance........$0.60

TYPE 439

TYPE 410 RHEOSTATS

The new A.C. tubes require low resistance rheostats capable of carrying ample current.

Resistance	Current	Price
.5 ohm	3.5 ampere	$1.25
1.5 ohm	2.0 ampere	1.25



TYPE 410

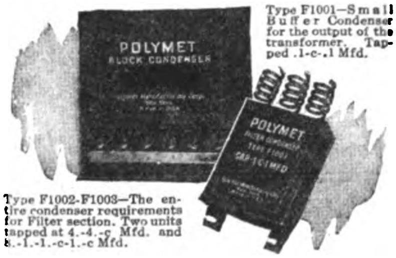
Write for diagram showing how to adapt the filament wiring of the popular type of receiver to A. C. operation by use of General Radio parts especially designed for this purpose.

Your local dealer should have the necessary parts in stock.

If he is unable to supply you with all the items required, we shall be glad to send them to you prepaid upon receipt of list price.

GENERAL RADIO CO., Cambridge, Mass.

Use Polymet Products



Type F1001—Small Buffer Condenser for the output of the transformer. Tapped .1-c-.1 Mfd.

Type F1002-F1003—The entire condenser requirements for Filter section. Two units tapped at 4.-4.-c Mfd. and 8.-1.-1.-c-1.-c Mfd.

For **RAYTHEON "ABC" Eliminators**

For efficiency and permanent satisfaction you can't beat Polymet Products.

More and more Radio Engineers are every day specifying Polymet Products because they know by experimentation that they are the leaders. To insure lasting, satisfactory results for Battery Eliminators, Power-Packs and Electric Sets buy only Polymet "better made Radio Essentials." They are the best.

Send for our latest booklet showing some of the most popular circuits and the complete line of Polymet Products.

Polymet
Manufacturing Corporation
599 Broadway, N.Y.

POLYMET PRODUCTS

SET BUILDERS

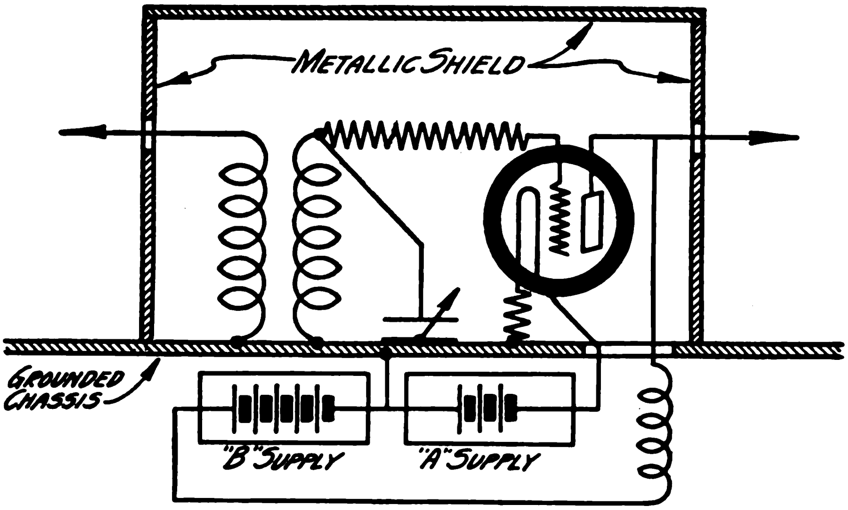
Write us before you build

BEFORE you build, get our prices on the parts you are planning to use.

We handle only brand new apparatus—standard makes that are fully guaranteed. QUANTITY sale of QUALITY parts explains our low prices. Compare with others and see why thousands of fans look to us as radio headquarters.

All the latest kits, accessories and parts—a million dollar radio stock to choose from.

CHICAGO SALVAGE STOCK STORE
Dept. PR 509 S. STATE STREET
CHICAGO, ILL.



THE ARRANGEMENT OF A SINGLE STAGE IN THE LC-28

FIGURE 10: *This schematic drawing gives the general arrangement for one stage of high-frequency amplification in its shield. Notice how the wiring is simplified.*

"B" power-pack, if one is used. All of the current, therefore, must flow through the condenser C and through the primary P. The condition for the greatest transfer of energy, with a given amount of coupling between the coils P and S, is obtained when the voltage E3 across the primary coil P equals the voltage E1 across the plate to the detector. This means that the drop in voltage E2 through the condenser C should be kept as low as possible. In the design employed in the LC-28, the impedance of this condenser at the highest wavelengths is approximately only 16 ohms, whereas the impedance of the primary is hundreds of times that amount when the circuit is tuned, so that the plate circuit has extremely high efficiency.

The coupling between the coils P and S, in the case of this new receiver, is probably greater at the high wavelengths than has ever been used heretofore in this type of design, and this is accomplished with perfectly stable operation.

Also, the step-up voltage ratio between the primary and the secondary is greater than heretofore used, giving a maximum amplification averaging 9 per stage for the whole frequency range used in broadcasting. This great gain has usually been considered almost impossible for a high-frequency amplifier that uses no neutralized circuits. It might be interesting to note as a comparison that the average amplification in last year's LC-27 was about 3.5 per stage.

Figure 8 shows at B a curve of the amplification factor of an ordinary standard high-frequency stage of amplification. Notice that at about 750 kilocycles and above the curve extends in a rapidly rising line. This is due to regeneration, and it is this effect that brings about the unstable condition and unwanted oscillation. If regeneration were eliminated from this same circuit, the curve would be smoother and stable operation would follow the general line of the curve BB.

The amplification curve of the new LC-28 is shown at A, and it will be noticed that there is little or no regeneration present. The curve falls off at high frequencies to an average value of about 7 from 750 kilocycles to 1,500 kilocycles, which is more than ample amplification. From 750 kilocycles to the top of the broadcast range a value of about 10 per stage is obtained, which gives great sensitivity.

Another interesting feature of the new circuit is that by the use of valves such as the new Zetka Z-112-a, having an unusually low plate impedance, the maximum amplification is obtained. The plate circuit is much more readily tuned to the frequency of the following grid circuit when the impedance of the valves is of a low order. It was found that in this system of amplification, the *mu* of the valve played a very small part in obtaining this great amplification, due to the large effective capacity of high *mu* valves at high frequencies. The main factors are a low input capacity between the elements (which goes with a low *mu*) and a low plate impedance.

In Figure 10 is shown the general arrangement of the condenser, the coil, the choke and the grid resistance inside the shielded stage used in the LC-28.

It might also be interesting to note that the whole circuit, consisting of three stages of this type of high-frequency amplification, may be wired up with less than 5 feet of wiring, including the wiring to the detector stage.

The plate circuit of the detector is by-passed and a high-frequency choke inserted in the lead of the low-frequency amplifier, so that it is impossible for high-frequency currents to get in along this lead and on to the low-frequency amplifier. The high-frequency currents are kept in the "can" housing the detector tuning circuit, and in this way "over-all regeneration" back to the first valve is eliminated.

A simple tuning scale showing the separation of stations is shown in Figure 2.

The volume control consists of a variable resistance connected in series with the positive lead to the filaments of the three high-frequency valves. By this method, the volume may be controlled from a whisper to maximum.

What this control unit really does is to increase the impedance of the valve as the filament current is reduced, thus cutting down the amplification obtained and, consequently, the volume of the received signals.

In the next article on the LC-28 constructional details will be given for building this amplifier which, it is believed, will give the kind of results long looked for by the experimenter and set-builder, but not often found.

For the benefit of the set builder who wishes to purchase the parts necessary for building the LC-28 Receiver now, in order that he may have them on hand when the constructional article appears in the October issue of POPULAR RADIO, the list of instruments and accessories is given below:

LIST OF PARTS FOR THE
LC-28 Receiver
TO BE FEATURED IN THE OCTOBER, 1927, ISSUE OF POPULAR RADIO

- 4 Hammarlund mid-line variable condensers, .000275 mfd.;
- 1 Hammarlund double drum dial;
- 1 Precision high-frequency transformer (4 coils), type 4-B;
- 3 Samson high-frequency chokes, type No. 125;
- 1 Samson high-frequency choke, type No. 85;
- 3 Aerovox moulded condensers, .02 mfd.;
- 1 Aerovox moulded condenser, .00025 mfd.;
- 1 Aerovox moulded condenser, .00075 mfd.;
- 1 Yaxley combination switch and rheostat, 6 ohms, No. 906-K;
- 1 Yaxley cable connector plug with cable, type 660;
- 4 Carter fixed resistances, 4 ohms, type H-4;
- 2 Carter Imp plugs and tip jacks, marked "Antenna" and "Ground," respectively, with insulating washers for "Antenna" jack;
- 4 Benjamin vibrationless sockets;
- 1 Lynch single-resistance mounting;
- 1 Lynch suppressor, 500 ohms;
- 1 Lynch suppressor, 600 ohms;
- 1 Lynch suppressor, 700 ohms;
- 1 Durham metallized resistor, 6 meg.;
- 2 Tait brackets;
- 1 Alcoa aluminum chassis;
- 4 Sets special aluminum box shields for LC-28;
- 1 Aluminum panel, 6 by 26 inches;
- 1 ¼-inch extension shaft.

Jim: Do you know how to eliminate static?

Bill: No.

Jim: Turn off your radio.

Two New Quality Products
by the makers of the famous
Hammarlund *Condensers*

The New
Hammarlund R. F. Choke

MODERN engineering practice has proved the value of R. F. chokes for confining radio-frequency currents to their proper channels, thus preventing unbalanced circuits and consequent distortion.
This is a *quality* idea, ideally exemplified in the use of the new style Hammarlund Choke. Made in two sizes: 85 and 250 millihenries, effective over the entire broadcast and amateur wave-band.

An Improved
"Hammarlund Jr."

THE famous Hammarlund Midget Condenser has been simplified. The new "Hammarlund Jr." has all essential features of the former model—soldered brass plates, aluminum frame, one-hole or baseboard mounting. Knob included.
In addition, it is equipped with a rotor lock which fixes the rotor in any position—an important advantage when used for neutralizing. Four sizes.

Wherever radio is known throughout the world, Hammarlund's reputation for precision quality is recognized. No other introduction is required for these two worthy new members of the Hammarlund radio family.
Write for Literature

HAMMARLUND MANUFACTURING CO.
424-438 W. 33rd Street, New York

For Better Radio
Hammarlund
PRECISION
PRODUCTS

YOUR OWN BUSINESS
Without Capital

Right now, there is an opportunity in your locality to profitably devote your spare time or all your time to a pleasant, easy and profitable business—one that does not require any training or capital.

The publishers of POPULAR RADIO offer you an opportunity to become their local representative to take care of expiring subscriptions and new subscriptions for POPULAR RADIO and one other popular magazine that they publish.

SALARY AND COMMISSION
All material will be furnished you free of charge and you will be paid an attractive commission and salary.
Mail coupon for full particulars.

POPULAR RADIO, Dept. 46,
627 W. 43rd St., New York City.
Send me full particulars regarding your salary and commission offer to local representatives.
Name..............................
Address...........................
....

POPULAR RADIO DEALER AND JOBBER LISTS AVAILABLE TO MANUFACTURERS

The Service Bureau of POPULAR RADIO is able to place at the disposal of radio manufacturers a list of over 21,000 radio dealers, 3,926 radio manufacturers, 1,746 jobbers and 326 manufacturers' representatives. These addresses are immediately available for circularizing prospects for new Fall lines, and more detailed information and rates will be gladly supplied to those who wish to take advantage of what is without doubt one of the most carefully kept lists at present offered for use.

Address all inquiries to:

Service Bureau
POPULAR RADIO, Inc.
627 West 43rd Street
New York, N. Y.

LISTENING IN

PRACTICAL *pointers from experimenters and broadcast listeners. What helpful hints can* YOU *offer to your fellow fan? Readers are invited to address their letters to the Editor of this Department.*

CONDUCTED BY DAVID LAY

The Tungar Valve in a New Rôle

THAT the ordinary Tungar rectifying valve, commonly used in battery chargers, has marked photoelectric properties, is a fact that few would suspect. The writer happened to discover it while experimenting with a burnt-out 6-ampere valve having a very short break in the filament—a break so short, in fact, that a corona-like discharge or glow appeared in the valve on connecting it to the 120-volt light circuit.

But, strange to say, no glow would appear if the room were darkened before closing the circuit! It was evident that some sort of photosensitive effect was at work, which made the valve a better conductor when exposed to strong sunlight than when placed in the dark.

A closer examination of the valve revealed the secret. The familiar discoloration which all Tungar valves exhibit, and which is due to the purifying agent or "getter" employed in exhaustion, in this particular case took the form of a mirror-like deposit of metal on the upper hemisphere of the valve. The lower portion of the glass was relatively clear, so that light entering from below struck the spherical mirror surface and, to a certain extent, was focussed on the broken filament.

Now, the magnesium metal used as "getter" in the Tungar valve is definitely photoelectric, that is, it liberates electrons on exposure to light. Ionization is thus produced in the argon gas filling the valve, which lowers the critical voltage required for the production of a glow discharge. Light falling on the valve "triggers" off the 120-volt discharge, thus giving rise to the phenomenon described above. More consistent results were obtained by connecting a tapped "B" battery in circuit so as to boost the applied voltage to just below the critical potential.

Many experiments are possible—as, for example, the control of power by a light ray—by making use of this interesting property.

The writer demonstrated the last mentioned possibility by connecting the secondary of a telephone induction coil in series with one filament lead, while to the primary was connected a 2-volt flashlight lamp. On reflecting a beam of light on the tube in an otherwise darkened room, enough current was passed to light the lamp to full brilliancy.

More impressive experiments using a relay are quite feasible and might prove to be useful.

—CHARLES D. SAVAGE, *Portland, Ore.*

* *

How to Eliminate Home Interference

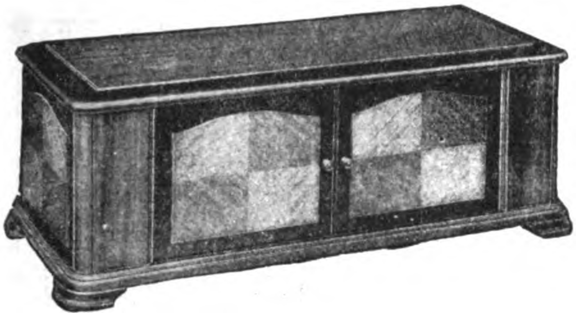
THERE are many devices in the average home that may ruin the reception of the finest set on the market. A vacuum cleaner, an electric refrigeration plant or any other general utility device within the house may not only ruin the reception in the home where they are being used but they may disturb the reception in the entire neighborhood. The interference may be louder at some house in the next block than it is at the place where the interference is being propagated.

The making and breaking of a circuit in a motor, or moving parts in other devices cause small sparks which generate radio waves. This spark transmission, which has no definite wavelength, will use distant wiring as a form of antenna, and is very hard to tune out of any set.

Several manufacturers have put out appliances to eliminate this disturbance, or interference.

The real solution, however, is to correct the trouble at its source. This may be done by using high voltage condensers, shunted across the line and grounded at their midpoint.

—G. D. PRESTON, *El Centro, Cal.*



PRESENTING THE NEW BROWNING-DRAKES

AFTER several years of intensive research by Prof. Glenn H. Browning and Dr. Frederick H. Drake, the laboratories of the Browning-Drake Corporation have brought to commercial form, a new conception of the world-famous Browning-Drake.

The ability of the new receivers to demonstrate remarkable distance performance, to give fine tone and cut through the strongest local interference, gives them an unmistakable appeal.

Model 7-A above and model 6-A below are the first Browning-Drakes to use more than **five tubes.**

LOOK FOR THIS

TRADE MARK

These new models embody many mechanical refinements, including a highly efficient and novel tuning drive system.

Model 7-A has the following features: Single Dial, Seven Tubes, Completely Shielded, Illuminated Drum Control, Super-Selectivity. This model can be had in either a two tone mahogany or walnut. Size: length, thirty inches; depth, fifteen inches; height, eleven inches. A console base is available for this model if desired. List price without tubes $145.00; with console $185.00.

DEALERS: Browning-Drake now offers a complete line of receivers and kit parts. Almost three times as many Browning-Drake parts are sold as those of nearest competitor. Write or wire for further information TODAY.

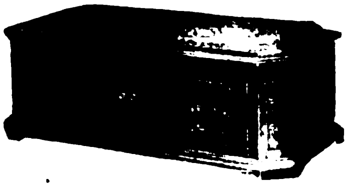
BROWNING-DRAKE CORPORATION, Cambridge, Mass.

Model 5-R

This five tube model is still very popular. Famous Browning-Drake slot wound radio frequency transformer is used. Provision for power tube in last stage. Cabinet is two tone Duco mahogany finish. List without tubes and batteries $95.00.

Model 6-A

Six tube. Uses conventional Browning-Drake circuit with slight modifications. Four tube audio amplifier gives greater volume. Single Dial. Illuminated Drum Control. Cabinet is two tone Duco mahogany. 27 inches long; 15 inches deep; 11 inches high. List without tubes $105.00.



THE PERFECT WARFORD REPRODUCER

Makes Possible an Electric Phonograph at Small Cost

Replaces the regular reproducer on any old or new phonograph (without the use of tools) and makes it possible to play your favorite records through your radio set. In designing this reproducer, H. P. Donle, the famous radio inventor, made it possible to transform your old phonograph into a life-like recreator of music. It operates on the same principle as the latest and most expensive types of talking machines.

Price $11.50

This is also furnished with a volume control at $16.00. The use of a scientifically designed volume control eliminates any chance of distortion and insures the purity of tone. We strongly *recommend this to the music* lover. We also furnish a supporting bracket for those who do not wish to attach reproducer to tone arm. Side Arm Bracket $2.00

WARFORD ELECTRIC, Inc.

42 WHITEHALL STREET

NEW YORK, N. Y.

TOBE

Trade Mark Reg'd U. S. Pat. Office

B - BLOCK

No. 660

Specified for the
SILVER-MARSHALL UNIPAC

In value—in performance this new TOBE B BLOCK, 660, lives up to the reputation to which its name entitles it. Chosen by McMurdo Silver for his new UNIPAC, it plays its part in the fine results obtained from this carefully engineered power amplifier.

Price, $12.00

TOBE Condensers and B Blocks are found in all the leading radio units. Send for Pamphlet L-9.

Tobe Deutschmann Co.

Engineers and Manufacturers of Technical Apparatus
CAMBRIDGE, MASS.

RADIO CATALOG *free*

Every live dealer in radio sets, parts, accessories, supplies, etc., should have a copy of this bargain catalog. You will be amazed at the thousands of money-saving radio items illustrated and listed in this storehouse of everything you could possibly need in radio.

The GUIDE BOOK to Bigger RADIO PROFITS FOR YOU

The book contains all the latest and most popular kits—all the famous, nationally known radio parts, accessories and supplies—the very newest types and designs of table cabinets and consoles—everything at prices that mean bigger profits for you.

Short Wave Section Our catalog contains a section devoted to a showing of the highest grade short wave receiving and transmitting apparatus. Also the finest electrical appliances for use in the home.

Dealers Make More Money ● Tie up with a house that carries large, complete stocks, that gives you the highest quality radio parts, that insures speedy shipments and 100% satisfactory service.

Our wholesale vest pocket price list and discount sheet and catalog will be sent to you on request. Write on your letterhead.

BUT WRITE QUICKLY

SHURE RADIO COMPANY
335V Madison Street Chicago, Illinois

How I Got Rid of the Bulky Loop in My Superheterodyne Receiver

THERE are in use today numerous superheterodynes and other types of radio sets that operate with a loop antenna.

It is possible to discard the usual type of loop and substitute for it a small coil that may be enclosed in the radio cabinet. The only change necessary is the addition of a ground wire, which connects with one of the loop terminals of the set.

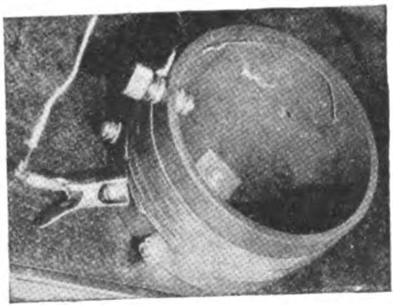
One of the easiest to construct and one of the most efficient types of coil is the solenoid. This consists essentially of a layer of magnet wire wound on a cylinder of bakelite, hard rubber or other insulating material, with provisions for varying the amount of wire in the circuit.

A COIL ANTENNA

FIGURE 2: *The left-hand picture shows how the brass mounting strip is attached; at the right is shown the arrangement of the four terminals on the coil form.*

The coil shown in Figures 2 and 3 was wound on a 3½-inch hard rubber cylinder. One end of the coil was connected to a binding post fastened near one end of the cylinder; the other terminal was formed by passing a small bolt through an ordinary battery binding post nut and then through the hole in the cylinder bored for that purpose. The wire was fastened to the terminal in the usual way with a nut on the inside of the cylinder. Two taps, one at five turns and the other at ten, were taken off, and provided with similar terminals.

This method of making terminals, that is, with the use of bolted-on binding post nuts, is employed so that a clip may be provided on one of the loop terminals of the set. The wavelength of the coil is varied by moving the clip from one terminal to another. This adjustment, however, usually will have to be made but rarely.



THE COMPLETED COIL

FIGURE 3: *The wavelength of the coil may be varied by moving the clip from one terminal to another.*

An alternative way of providing for the varying of the coil wavelength is by using a switching device, such as the switch point and lever combination common to radio sets of a few years ago.

The completed coil is fastened to the interior of the radio cabinet by means of a small screw and a brass angle strip. One of the coil terminal bolts serves to hold the cylinder to this strip. The coil may be fastened to the sub-panel of the set, if space permits.

Actual dimensions of the coil antenna such as the number of turns, number of taps, and so forth, will vary with the type of radio set with which the device is to be used. The method of trial and error is perhaps the best in finding the most efficient combination. The wire used need not be of any particular size, and may be insulated with cotton, silk, enamel, or by air spacing. Generally speaking, the wire should be as large in diameter as practicable. Stranded wire, such as "Litz," is perhaps the most desirable.

The coil described should be grounded at one end for reception of low-powered or distant stations.

The use of a ground wire eliminates the directional properties of the coil antenna, and greatly increases the volume.

This type of antenna is small in size, is practically non-directional, and therefore requires no adjustment.

In use, the coil will be found to function best on the lower wavelengths with fewer turns of wire in the circuit, and on the higher wavelengths, with a larger number of turns.

—WALTER E. BURTON, *Kenmore, Ohio*

* *

An Easy Way to Make a Vernier

A NON-REMOVABLE, top binding post, with but only a little alteration, will serve as a first-class vernier for radio dials.

Obtain a post of generous size. If you have one around the workshop, which you discarded because of the corrosion of its brass parts, it will do nicely. Screw the top down very tightly, closing the gap permanently.

Cut a piece of fine-grained cork to the same diameter as the base of the binding post, and 3/16 of an inch thick. Cut a hole in it to allow for the passage of the screw. Apply a little good glue to base of the post and force the piece of cork on; the pin will hold it in place. A small brass washer is needed between the cork and the panel.

After the nut is adjusted behind the panel, an extra nut should be put on to lock the vernier at a fixed tension.

—JOHN C. HEBERGER, *Rochester, N. Y.*

A Condenser-Antenna for the Automobile Radio Set

A CONDENSER-ANTENNA is one of the best types of pick-up devices to use with a radio set in an automobile. The idea of the condenser-antenna is old, and it is surprising that it is not more used by the experimenter who wants an antenna that will give a maximum of signal strength with a minimum of size. The condenser-antenna, as its name suggests, is formed of two plates of metal suspended several feet apart, with the upper one well insulated. The lower plate is used for the ground, and the upper one for the antenna. This antenna may be modified for use in an automobile by fastening the upper plate just inside the top of the car, and using the body of the car for the lower plate. The upper plate may be of almost any kind of metal. The larger this upper plate the better will be the results. Medium-mesh copper or brass screening, or a piece of thin sheet copper or brass will make the most efficient and best looking antenna. Even ordinary tin foil or lead foil may be used by fastening a large sheet of it to the top of the car and sewing a piece of cloth over it to keep it from getting torn. An insulated wire should be soldered to the metal plate and brought down to the antenna binding post on the set, taking care that the plate and the lead to it do not touch any of the metal parts of the car body. The ground binding post should be connected to the metal body of the car, or to the grounded terminal of the storage battery. (See Figure 4.)

—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*

* *

How to Use the Same Panel More than Once

FREQUENTLY, a set builder desires to change the location of instruments on the panel of his set and is deterred from this either by the unsightly appearance of the open holes left where the instruments originally were, or by the expense occasioned by the other alternative—buying a new panel.

There is, however, one way of re-using a panel several times which may, if done neatly, actually improve on the looks of the original panel.

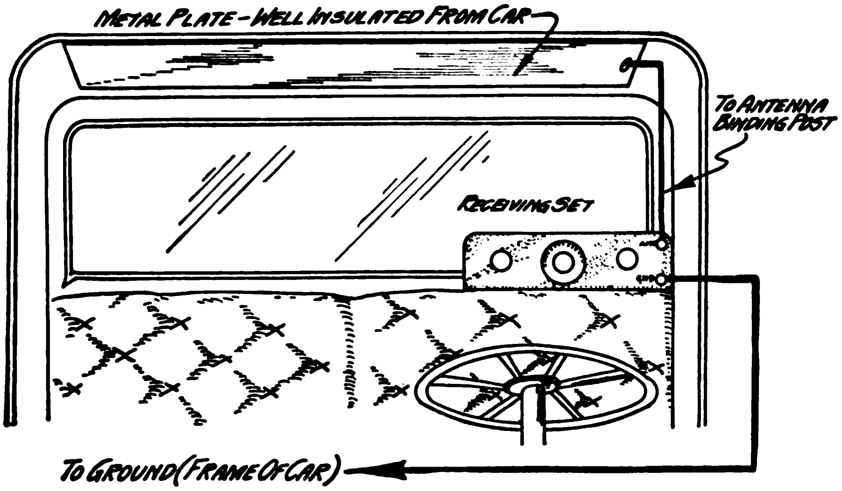
Lay out and drill the panel as desired, disregarding the previous drillings. Then, with sealing wax, fill all the holes that are not to be used in the new layout, being sure to smooth the wax flush with the panel front. Then, with coarse sandpaper, go over the front of the panel thoroughly in all directions to slightly roughten it. Next, secure from your local book-binder a piece of leather or leatherette such as is used in binding ledgers. Color, of course, is optional and he will have several varieties from which you may make your selection. Then with a thin layer of shellac cover the face of the panel. The leather is then applied to the panel and ironed out with some smooth object—a flat iron is good for this purpose—to eliminate wrinkles and air bubbles between the leather and the panel. Then, place the panel, leather side down, on some flat surface and pile weights on the panel so as to apply as even a pressure as possible and leave it there for twenty-four hours. At the end of this time place the panel, leather side down, on a board and with the point of a sharp, thin-bladed penknife trim the leather to the size of the panel, drilling the leather out of the new holes.

—C. J. SHUTTLEWORTH, *Clarksburg, Va.*

* *

Trouble Caused by a Dial Telephone

I RECENTLY had an interesting case of interference from the dial telephone that caused me much trouble and cost me some little money before I discovered the cause.



A SIMPLE AUTOMOBILE ANTENNA

FIGURE 4: *A large sheet of copper or brass screening fastened to the top of the car forms an efficient and inconspicuous antenna for the portable radio receiver. It must be well insulated, however, from the body of the car, which is used as a ground.*

Bradleystat
PERFECT FILAMENT CONTROL

For noiseless, smooth filament control and maximum range, ask your dealer for the Bradleystat. This well-known graphite disc rheostat can be used for ALL TUBES, without change of connections. The bakelite knob is removable, if desired. The one-hole mounting makes the Bradleystat easy to install.

Bradleyleak
THE PERFECT GRID LEAK

With a range from 1/4 to 10 megohms, the Bradleyleak offers a variation of adjustment that adapts it to any tube or any circuit. A small grid-condenser can be attached direct to its terminals. One-hole mounting.

Bradley-Amplifier
Resistance-Coupled
PERFECT AUDIO AMPLIFIER

For perfect tone quality, use resistance coupling, and for convenience and reliability, ask your dealer for a Bradley-Amplifier. Ready to install in your radio set.

The Perfect Audio Amplifier Amplifies without Distortion
Not Affected by Age, Temperature, or Moisture
Bradley-Amplifier

Mail this coupon to

ALLEN-BRADLEY CO.
276 Greenfield Ave., Milwaukee, Wis.

Please send me your folders on Allen-Bradley radio devices, including the Bradley-Amplifier.

Name..................................
Address...............................

Harry Alter's Radio Book for SEPTEMBER 1927 Dealers Only

just out!

GET YOURS QUICK

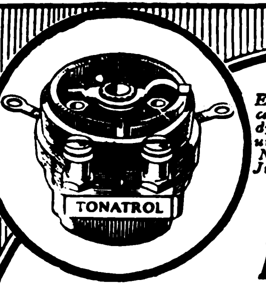
Don't wait! Send today for this wonderful book. See how 14,000 live radio dealers make bigger profits by buying from The Harry Alter Company, America's foremost wholesalers of receiving sets, kits, parts and accessories — the largest stock of standard, nationally advertised radio goods carried anywhere.

RADIO'S GREATEST CATALOG

Compare its low prices with those of any other catalog. You will be amazed. Note: We sell only to radio retailers. Write for your copy NOW.

The Harry Alter Co.

1760 Michigan Ave., CHICAGO, ILL.



Exclusively Licensed by Technidyne Corporation under U.S. Patent No. 1593658, July 27, 1926.

And Now!

"Tonatrol"

A True Tone and Volume Control

At last, you can have the exact volume you want—to meet your mood and fancy. "Tonatrol" makes this possible—regulates volume from low, soothing music to the deepest inspiring tones—instantly!

Reception will be much more satisfactory with "Tonatrol." Made with genuine Bakelite. Can be installed in a jiffy. Get "Tonatrol" from your dealer today.

Tonatrol—Standard Volume Control.........$1.50

Tonatrol—Type W. S. (with filament switch attached)...........$2.00

Installation Booklet for the correct way to control volume free on request.

175 Varick St., Dept. 43A, New York, N.Y.

ELECTRAD

I have been using a resistance-coupled Four-circuit Tuner because I like its tone better than that of any other set that I have built. Some months ago it started to behave as if something was radically wrong with it. It would stop suddenly in the middle of a concert, and then, just as suddenly, come on. Sometimes it would go on and off repeatedly, as if some one were playing with a switch. I went over it thoroughly for loose connections—took out all the jacks and replaced them with new ones—got new B batteries—but all to no avail. By experimentation I found that when it went off, the low-wave stations, which normally came in on the third or fourth tap, could be brought back by placing the switch on the 7th tap; but nothing would bring back WOO and WIP when they went off.

After several months I discovered that the result was produced in some way by the dial telephone, and that all that was necessary to bring a station back when it went off was to lift the receiver of the telephone and hang it up again. As soon as it was put back on the hook the station came back with a bang. (Sometimes it was necessary to dial one number while the telephone was off the hook.

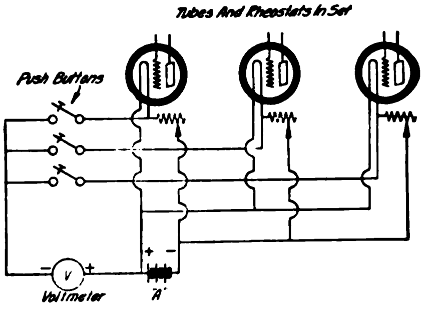
With this discovery I thought I had things fixed. But recently it has been getting harder and harder to bring the stations back. The tap for the low-wave stations has been permanently advanced to the 5th, and WOO and WIP have been permanently advanced beyond the 7th tap. Hanging up the receiver only brings the station back for a second or so, when it immediately goes off again; and sometimes no amount of fooling with the telephone will bring it back. The interference which at first was only temporary has become permanent for the higher wavelengths, and is becoming permanent on the lower ones. Sometimes for two or three days at a time it is impossible to get any station on five tubes with sufficient volume to be worth listening to.

I have not had time to experiment fully, and so do not know what effect would be had by changing the position of the radio set or the lead in; but I am under the impression that trouble I had with a set that was not located anywhere near the telephone was probably due to the same cause.

—JOHN J. CAMPBELL

EDITOR'S NOTE: The symptoms of this trouble indicate an open grid circuit in either the detector or one of the amplifier tubes.

A solution would be to check over the values of all the grid-leaks and substitute lower values of resistance where a tube may be blocking, due to the large surge generated by the strong impulse induced by the action of the telephone.



A VOLTMETER HOOK-UP

FIGURE 5: *The voltmeter may be used, by means of push buttons, in this circuit, to measure the filament voltages of the various tubes in a receiver or transmitter.*

How to Make a Voltmeter Hook-up for a Transmitter

WHEN a separate rheostat is used for each tube or valve in a transmitting or receiving set, an individual voltmeter should also be used for each separate valve if its filament terminal voltage is to be read correctly. If only one voltmeter and no switch are used, the only reading that it is possible to get is the battery-terminal voltage; and that does not tell much about the voltage the valve actually receives. An ammeter may be used, of course; but, as is well known, it is much better and much less hard on the valves to use a voltmeter. By using white-top, nickel-plated push buttons, one to each tube, and connecting them as shown in Figure 5, a voltmeter may be used; and, by pushing the proper button, it will give the filament-terminal voltage of the valve connected to that button. Each push button and rheostat should be numbered to correspond to the valve to which they are connected, so that there will be no mistake in adjusting the rheostats.

—CHARLES F. FELSTEAD (6CU), *Los Angeles, Cal.*

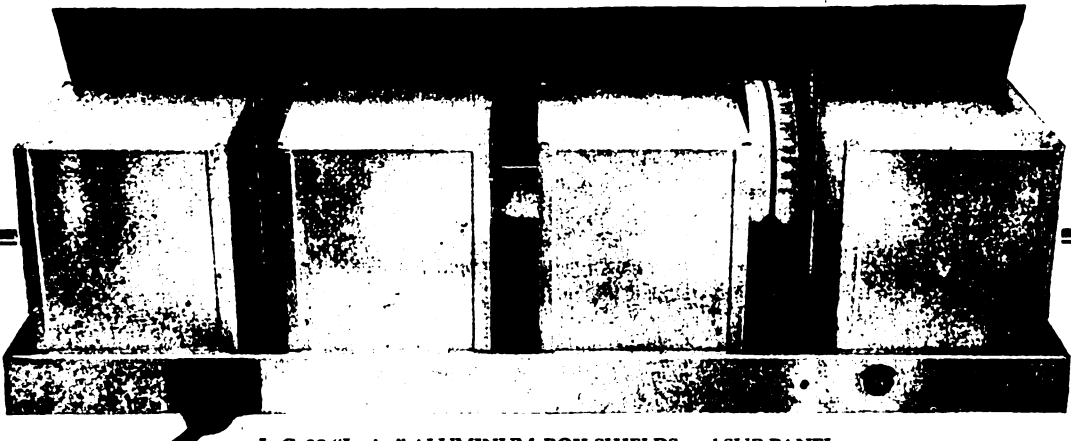
* *

A Fan Who Logged 402 Stations in 1926

CLAIMING a word's record in number of stations heard, Mr. William McDonald of Chula Vista and Los Angeles, challenges all DX hounds to equal his achievement. He has logged 402 stations during the past year, including all stations of any size in every state in the Union, and the large stations of practically every foreign country; besides this he had logged hundreds of small stations which broadcast for local reception. Mr. McDonald's book of stamps and verifications is insured for two thousand dollars.

Mr. McDonald has received all of his stations on a loudspeaker. He sometimes sits until dawn with his ear tuned for foreign signals. No special section or conditions have been responsible for his success, as some of the stations were logged in Chula Vista, and others in Los Angeles.

—G. D. PRESTON, *El Centro, Cal.*



L. C. 28 "Junior" ALUMINUM BOX SHIELDS and SUB-PANEL

More Aluminum Shielding and Sub-panels this year than ever before

At the R. M. A. Trade Show in Chicago in June more Aluminum for shielding, sub-panels, chassis and linings was displayed than all other metals combined.

Mr. L. M. Cockaday has shielded the L.C. 28 to insure amplification, tone quality, sensitivity and selectivity and has specified an Aluminum Sub-panel and Aluminum Box Shields. An Aluminum front panel with walnut grained finish is also used.

The box shields called for in the L.C. 28 were designed especially for this set and are easily applied without fitting or soldering. ALCOA Aluminum is found to be the most effective material for this purpose. These shields are known as

"Junior" ALUMINUM BOX SHIELDS

Jobbers, write our nearest office for prices, terms, or information regarding L. C. 28 Sub-panel and "Junior" Box Shields.

Albany, N. Y.
Boston, Mass.
Buffalo, N. Y.
Chicago, Ill.
Dayton, Ohio
Detroit, Mich.
Indianapolis, Ind.
Kansas City, Mo.

ALUMINUM COMPANY OF AMERICA
2321 Oliver Building, Pittsburgh, Pa.
Offices in 18 Principal American Cities

New Haven, Conn.
Newark, N. J.
New York, N. Y.
Philadelphia, Pa.
Pittsburgh, Pa.
San Francisco, Cal.
St. Louis, Mo.
Toledo, Ohio

Cleveland, Ohio
ALUMINUM COMPANY OF CANADA, LTD., TORONTO, MONTREAL
Washington, D. C.

ALUMINUM IN EVERY COMMERCIAL FORM

Are You Planning to Use the New Alternating Current Tubes?

Those who are planning to build new A. C. receivers or convert their old receivers by the use of A. C. tubes will do well to follow the activities of the POPULAR RADIO Laboratory. Our Laboratory experts are now planning and building full A. C. receivers of every type and this work will be described in full detail in the forthcoming issues of POPULAR RADIO. These new numbers of POPULAR RADIO will make radio history and those who are not subscribers will be wise to place a standing order with their news-dealer for a copy of POPULAR RADIO.

Of course, it is always better to subscribe at $3.00 a year and be SURE of receiving your copy.

Subscription Dept.

POPULAR RADIO, Inc.
627 West 43rd Street, New York, N. Y.

CORWICO

Radio's Best Wire

"From the Ground Up"

"Corwico" is the wire used by Mr. John Harrison Hartley, holder of the world's international set-building championship. "Corwico" wire is also specified by the leading set manufacturers and hundreds of professional set builders. For all-around efficient service and for meeting the requirements of high class workmanship "Corwico" radio wire has no equal.

CORWICO "FLEXIBUS" HOOK-UP WIRE

"Corwico" Flexibus (Solid or Stranded) is a flexible insulated tinned copper hook-up wire which makes a neat and efficient product for "point to point" and sub-panel wiring. It is covered with a varnished cambric flameproof insulation finished in red, green, yellow, brown or black.

"Corwico" Radio Wires

Antenna Wire
(Solid, Stranded and Braided)
Complete Aerial Kits
Magnet Wire
Battery Cable
Bus Bar Wire
Hook-up Wire
Lead-in Wire
Annunciator Wire
Loop Aerial Wire
Litz Wire
Flexible Wire

"Corwico" Radio Wires are sold by all leading dealers. Write for free booklet on radio wires and their uses.

CORNISH WIRE COMPANY
30 CHURCH STREET NEW YORK CITY

PRECISION
Announces
A
Complete New Line
of Coils

Guaranteed within 1% of Absolute Accuracy

The latest improved types for the set-builder, radio engineer and amateur. Coils for practically every type of circuit—wound and designed with the greatest scientific precision. Write for the new Precision Catalog and prices. Keep up to date with the trend in radio.

PRECISION
TUNING UNITS

Designed expressly for the experimenter who desires a tuning unit of as flexible a character as is possible to combine in one design. Equipped for single hole mounting. Type 3A is a little more accurate than type 3B, but it is not as compact. Price, type 3A, $5. Price, type 3B, $3.75.

RADIO FREQUENCY
TRANSFORMERS

For the amateur who wishes to experiment with the single dial calibrated receiver. Secondaries are wound to the extreme accuracy of 2-10ths of 1 per cent. The type 4A coils are probably the most accurate coils on the market today. Price per set of three, $6.50. Type 4D more compact, but not as accurate, $5.

News About
the New LC-28

The Precision Coil Company announces that for the third consecutive year it will be a distributor of the Laurence Cockaday Receiver. The new LC-28 which will appear in this magazine in October will be sold in complete kit form. Write us for particulars.

PRECISION COIL CO., Inc.
209 CENTRE ST. NEW YORK CITY

A Coil for Every Circuit

"Can I Learn Radio by Mail?"

(*Continued from page* 151)

Radio, and building and operating their own apparatus, prove that the printed page can convey instruction in radio even without the assistance of an instructor. The addition of the instructor, the lesson sheets and the correction of papers only increases the chances of success.

Correspondence study in universities and colleges had become so well established by 1920 that the Bureau of Education, United States Department of the Interior, issued a pamphlet on the subject. A reading of this bulletin will remove any doubt as to the practical value of correspondence instruction. The names of 73 institutions that offer correspondence courses are listed, and 61 of these are supported by public funds. The following statement is made by J. W. Scroggs, Director of Extension, University of Oklahoma:

> "Diligent inquiry has failed to find a single instance where a competent, conscientious instructor has taught the same subject both in class and by correspondence who does not find words of commendation for correspondence study. Many testify to getting better results by correspondence teaching than in class instruction. Advanced students are competent witnesses and their testimony is overwhelmingly favorable."

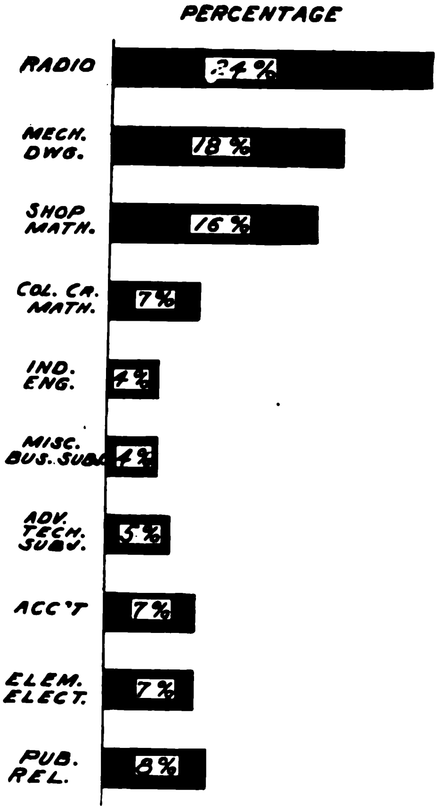
Another significant statement is:

> "Correspondence study is an invaluable method of instruction, almost the only one now practised on a large scale. Except in correspondence study, individual instruction has given place to the class method, save for the favored few who are able to meet the higher cost of private teaching."

Still another:

> "Correspondence students in general are serious persons, not childish in years or mind. Most of them are adults. The small minority of minors are old for their years, capable of learning and eager to learn. For those wishing intensive study in a single branch or two, classroom work is not adapted. Students must often take three or four studies to get the one they wish; they must not go faster than the class and the work must be managed in the interest of the group, not the individual. Practically all of the courses given in colleges and high schools and many that are not can be and are taught by correspondence."

The demand for correspondence instruction in radio is active. Astute men and women have grasped the fact that when several million persons suddenly begin to use radio it means a growing demand for radio experts in factories, ship and shore stations, schools, colleges, laboratories and wholesale and retail houses. Even the Morse code is taught by mail, though it is improbable that any student ever was able, without previous experience, to copy code messages at commercial speed.



24 PER CENT OF THE STUDENTS LEARN RADIO BY MAIL

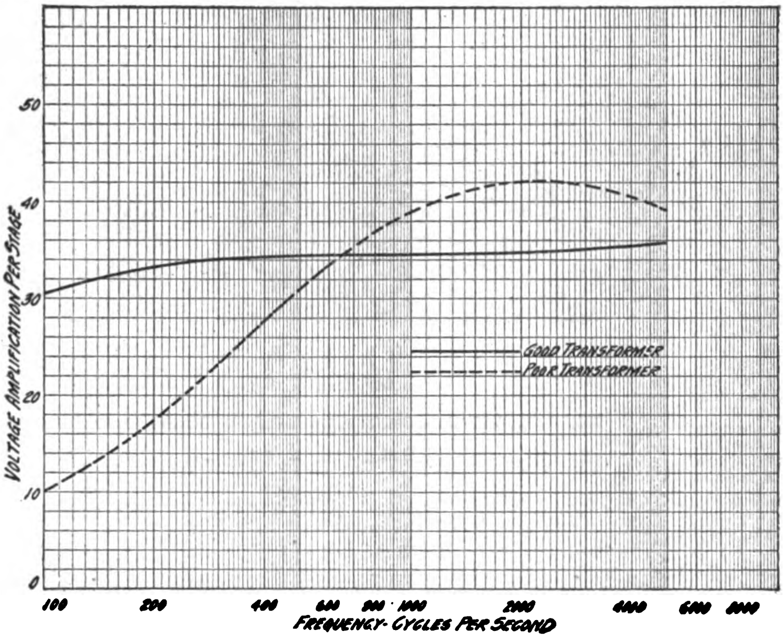
The above table shows the enrollment in the Miscellaneous Correspondence courses conducted by the Department of Engineering Extension of Pennsylvania State College, July 1, 1925, to January 1, 1926. The success of this form of instruction depends not only upon the school, but—and perhaps more particularly—upon the work of the student himself

Pennsylvania State College, which had more than 25,000 correspondence pupils in twenty-five years, never enrolled so many in so short a time as it did for the first radio course it offered.

With reputable correspondence schools and such institutions as the Y. M. C. A., and the many colleges that offer correspondence courses in radio, there is no reason why anyone who wants education in radio should not have it.

Moonlight and Radio

Can the moon, which has been blamed for so many human frailties, be blamed also for any effect on radio reception? An English experimenter has investigated the subject scientifically, and his findings will be reported in an article in the October issue of Popular Radio.



WILL YOU PERMIT POPULAR RADIO TO HELP YOU BUY A GOOD AUDIO TRANSFORMER?

THERE are three principal devices that determine the nature of the reproduction of any radio receiver.

The audio transformer is perhaps the most important one of these; it is the gateway through which *all* of the music-laden current must pass if good reproduction is to be had. If this gateway is too narrow; if it interferes with the easy passage of these currents, the best tubes, the best circuits or the best loudspeakers cannot compensate for the losses in quality sustained. The damage to reproduction is *irreparable*.

Transformers are judged not by the finishes on their containers but by their performance curves; the width of the gateway they open for the passage of the delicate, vibrating currents from the detector. Determining the measure of this gateway is a precisely scientific job, calling for the use of instruments and calculations that are beyond the laboratory or mathematical equipment of the average fan.

For over three years the laboratory staff of Popular Radio has been determining the audio-frequency response curve of transformers through the use of a special and highly accurate audio-frequency oscillator, and no transformer that does not come within the tolerance limits set by the Laboratory Staff can be advertised in the magazine.

The purchase of audio transformers advertised in Popular Radio may be made with every assurance of satisfaction, for they have survived a most rigid and painstaking examination. This is another instance of Popular Radio's conscientious vigilance that its readers may spend their money wisely and without fear of disappointment.

A list of Approved Audio transformers will be mailed to those making this request and enclosing a stamped and self-addressed envelope.

POPULAR RADIO, Inc.
627 West 43rd Street
New York N. Y.

FREE
Simplified
BLUE
PRINTS

You can have your choice of any one set of POPULAR RADIO Simplified Blueprints with your new or renewal subscription for POPULAR RADIO, accompanied by remittance of $3.00. These Blueprints will make it possible for you to build a tested and approved set. You, as a reader of POPULAR RADIO, know the many entertaining, interesting and instructive articles that are published each month. We promise that throughout the coming months POPULAR RADIO will hold more and more of interest for Radio Fans.

Ease, Economy and Accuracy in Construction

Simplified Blueprints make it possible for anyone, without previous knowledge of radio, to construct a highly efficient radio receiver. These Blueprints consist of 3 diagrams as follows:

Panel Pattern

This Blueprint is the EXACT size of the actual set. So accurate that you need merely lay it on your panel and drill as indicated. No scaling or measuring to do, no danger of ruining the panel through faulty calculation.

Instrument Layout

Here again you have an actual size print of each instrument and binding post and its exact location both on the panel and within the cabinet.

Wiring Diagram

The unusual feature of this Blueprint is that it is an actual size picture diagram of the finished set. Each instrument and other parts appear in exact size and the wires are so clearly traced from one contact to another that you can connect all terminals accurately without even knowing how to read a hook-up diagram.

Set No. 18—"*The Improved Raytheon Power-Pack*" (as described in the May, 1926, issue of POPULAR RADIO).
Set No. 22—"*The LC-27 Broadcast Receiver*" (as described in the October, 1926, issue of POPULAR RADIO).
Set No. 23—"*The LC-Senior Power-Pack*" (as described in the November, 1926, issue of POPULAR RADIO).
Set No. 24—"*The LC-Intermediate Power-Pack*" (as described in the December, 1926, issue of POPULAR RADIO).
Set No. 25—"*The LC-Junior Power-Pack*" (as described in the January, 1927, issue of POPULAR RADIO).

Use coupon below; indicate which set of Blueprints you want.

POPULAR RADIO
Dept. 49
627 West 43rd Street New York City

POPULAR RADIO, Dept. 49
627 West 43rd Street, New York City

Enclosed is my remittance of $...... in full payment for subscription, with Blueprints as checked below, FREE.

☐ **Set Number 18** ☐ **Set Number 23**
☐ **Set Number 22** ☐ **Set Number 24**
☐ **Set Number 25**

Name..
Street..
City.................... State............

BROADCASTS

A Receiving Set for Every Eighteen People

ACCORDING to unofficial estimates, this country leads the world in the per capita ownership of receiving sets, with one set for every eighteen people. England claims second place, with a set for every twenty people. Sweden, Austria, Denmark and Germany follow, in the third, fourth, fifth and sixth places.

* *

City Broadcasters Cannot Usurp the Ether

WHEN a broadcasting station from Chicago appealed to the Federal Radio Commission to be allowed to appropriate a wavelength from Omaha, the Commission refused permission. This action gives evidence that the Commission will not allow the large city broadcasters to usurp the broadcasting channels at the expense of the country at large. The separation of wavelengths in large cities is now established as at least 50 kilocycles.

* *

Radio Weather Maps Speeded Up

RADIO weather maps are now being sent four times as fast as they formerly were. The 45 or 50 minutes formerly required to transmit a complete map was found to be too slow to be of use to the Navy dirigible *Los Angeles*. C. Francis Jenkins, inventor of the slower method, has now devised a method whereby a complete map, 7 by 10 inches, may be transmitted in about 12 minutes.

* *

Radio Bootlegging in China

ADMIRAL BULLARD reports that the war lords of China are not all enthusiastic over the idea of radio broadcasting. Their feelings on the subject are so strong, in fact, that bootlegging radios into China is becoming almost as profitable as the kind of bootlegging practised on this side of the Pacific.

* *

Germans Prefer Crystal Sets

THE use of crystal and one-tube receivers still predominates in Germany. This is partly due to the lower cost of these types; also the fact that at present there is only one broadcasting station in each German city makes it unnecessary that receivers be highly selective.

* *

Doctors Ban Broadcasting as "Unprofessional"

AFTER considerable debate, the House of Delegates of the American Medical Association passed a resolution declaring it unethical for a physician to give a medical talk by radio except under the auspices of a medical society. Although it was considered proper for a doctor to give a broadcast talk anonymously, it was ruled that the doctor was to be held responsible if his name became public in any way. The opposition held that the resolution restricted too greatly the legitimate broadcasting of health talks by recognized physicians.

* *

Fans to Oppose Direct Advertising by Radio

BECAUSE the Federal Radio Commission does not have jurisdiction over the broadcasting of direct advertising, the United States Radio Society of Cincinnati has undertaken to find out how the broadcast listeners themselves may combat this evil.

"Through a recent questionnaire sent to listeners by the Society," states Mr. Paul A. Greene, the secretary, "a bitter opposition was found against broadcasting stations engaged in direct advertising over the air. The United States Radio Society immediately started a campaign against direct advertising over the air. Although complete plans have not been made to combat this evil, it is believed that through legitimate broadcasting stations, radio listeners and the press cooperating with the Society, this form of broadcasting will be exterminated."

* *

Who Provides Our Broadcast Programs?

ACCORDING to Radio Commissioner Bellows, only 21 per cent of the nation's broadcasting service is provided by manufacturers of radio sets and dealers in electrical apparatus. Over three-fourths of our broadcasting is provided by interests outside the electrical field.

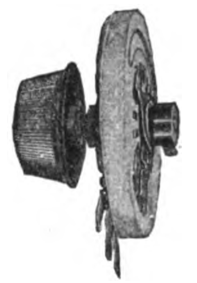
VITROHM RESISTORS and RHEOSTATS

cover every resistance requirement in current supply unit circuits

CHOOSE to build the power circuit you will this year and there is a *dependable* Vitrohm Resistor and Rheostat exactly engineered to meet your requirements.

Resistance is the heart of power circuits. Assure yourself of quiet, permanent, and unfailing service by insisting upon Vitrohms for radio. Each of the 95 Vitrohm Radio Resistors and Rheostats is guaranteed unconditionally for continuous duty in any circuit where it operates within its watts-dissipation rating. And Vitrohms have the highest watts-dissipation rating without resistance change of all resistance units.

The Adjustat



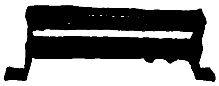
The Adjustat is a new Vitrohm Rheostat designed for use in radio current supply unit circuits.

Each Adjustat has 15 steps of resistance and is arranged for potentiometer connection. Its compact size, 2¾ inches in diameter, permits the use of several Adjustats in circuits where adjustable resistance is desirable.

Like all Vitrohm Products, the resistive element, wire having a low temperature coefficient of resistivity, is embedded and permanently protected by a fuse-on coating of vitreous enamel.

11 Types are available as listed below. The Adjustat is priced at $3.00.

507-79, 1 ohm, 4 amp.—507-71, 2 ohms, 3 amp.—507-72, 6 ohms, 1.5 amp.—507-73, 20 ohms, 1.0 amp.—507-74, 30 ohms, 0.75 amp.—507-80, 50 ohms, 650 m.a.—507-81, 600 ohms, 180 m.a.—507-75, 1000 ohms, 125 m.a.—507-76, 2250 ohms, 90 m.a.—507-77, 10,000 ohms, 40 m.a.—507-78, 25,000 ohms, 10 m.a.



Raytheon and QRS ABC Units

Three new Vitrohm Radio Products are immediately available for use in the Raytheon 350 m. a. and QRS 400 m. a. ABC Current Supply Units. Vitrohm Resistor 507-62, priced at $7.50, is tapped for all voltages needed in the QRS Circuits.

Vitrohm Resistor 507-70, priced at $7.50, is officially approved by the Raytheon Laboratories for use with their rectifier. (Illustrated.)

Vitrohm Rheostat 507-59, priced at $5.50, is designed for series primary control in both circuits.

Vitrohm Grid Leaks for Transmitting Circuits

Vitrohm Transmitting Grid Leaks are now available for the R.C.A. UX 852 and De Forest P and H transmitting tubes.

Ward Leonard has developed a complete standard line of transmitting grid leaks and rheostats covering all circuits up to and including those of 1,000 watts input. If you are interested in this and other radio apparatus, write for Radio Bulletin 507 (1927-1928). It will be sent without charge.

Ward Leonard Electric Company

31-41 SOUTH STREET
MOUNT VERNON, N. Y.

resistor specialists for more than 35 years

Modernize Your Radio

YAXLEY

APPROVED RADIO PRODUCTS

Improvements will bring you a new standard of convenience and comfort in radio entertainment.

Switching Rheostat

Serves as a filament switch and rheostat in one. Construction same as famous Air - Cooled Rheostat — gives correct voltage range and carrying capacity; feeds current slowly and evenly through use of large number of turns of special non - rusting. resistance wire. Resistance unit suspended in air to permit ventilation.

Furnished in sizes from 2 to 100 ohms $1.75

Pup Jacks

Easy to mount on front, sub or rear panels. The ideal Jack for Loud Speaker connections and for use as binding posts, for connecting Battery Leads, Ground, Antenna, etc. Mount in 5/16" panel hole.

Per Pair .... 25¢

Convenience Outlets

To give you greater joy with your radio, with less muss and fuss with its accessories, these Radio Convenience Outlets permit the wiring of the home so that batteries are out of sight, a loud speaker can be placed in any room, and the aerial and ground can be tapped like your regular electric convenience outlets. Do away with unsightly lead-in wires and set connections. Avoid damage to the building and acid stains on floors or furnishings. Outlet plates made single or in gangs. Fit any standard switch box or may be attached directly to plaster laths or studding.

No. 135—Radio Convenience Outlet for Loud Speaker and Head Phones........ $1.00

No. 136—Radio Convenience Outlet for Aerial and Ground 1.00

No. 137—Radio Convenience Outlet with Plug for Battery Connections 2.50

Yaxley also makes Air-Cooled Rheostats, Automatic Power Controls, Cable Connector Devices, Potentiometers, Jacks, Jack Switches, Special Switches, Phone Plugs, Midget Jacks and Plugs, Pilot and Panel Lights, Pilot Light Switches, Name Plates, etc.

Write for new illustrated and descriptive price sheet

At your dealer's. If he cannot supply you, send his name with your order to

YAXLEY MFG. CO.
Dept. P 9 So. Clinton St.
CHICAGO, ILL.

Transoceanic Calls Heard

POPULAR RADIO *has now completed arrangements for forwarding to transmitting amateurs in England, France, Germany, Austria, Ireland and Italy all calls heard (QSL) cards that may be addressed to them by American amateurs care of this magazine. These cards will be delivered through local agents in those countries, who have or can obtain knowledge of the present address of the foreign amateurs. Plans have also been completed by this magazine for forwarding to transmitting amateurs in this country in turn all QSL cards that may be addressed to them by amateurs from those countries. American amateurs are invited to send their cards to foreign amateurs through this office, which will not only assure safe delivery through the special agencies which are thus provided, but which will publish a monthly list in a "Transoceanic Calls Heard" department.*

Address your cards to the foreign amateurs by call numbers and enclose them in envelopes to—

The Calls Heard Editor
POPULAR RADIO
627 West 43d Street, New York

THE following stations were received and logged at the amateur station EF-8TIS, Rugles (Eure), France, using a Bourne receiver with one stage of audio and a single wire antenna:

NU-1NI—May 13, 1927; signal strength R3; DC note; interference and fading;
NU-2CS—May 19, 1927; signal strength R3; DC note on 30 meters; no fading;
NU-1ALR—April 29, 1927; signal strength R4; very good DC note; interference;
NU-2CX—May 23, 1927; signal strength R5; DC note; interference and slight atmospherics;
NU-8CPF—May 22, 1927; signal strength R7; good note; slight atmospherics;
NU-3AFW—May 21, 1927; signal strength R6; very good rectified AC note; some static;
NU-1ID—May 20, 1927; signal strength R7-8; very good rectified AC note; no fading;
NU-3AFW—May 19, 1927; signal strength R3; steady DC note; no static;
NU-8ALY—March 25, 1927; signal strength R6; DC note; atmospherics;
NU-5JF—May 7, 1927; signal strength R6; very good rectified AC note on 35 meters;
NU-1MV—April 4, 1927; signal strength R8; good note on 30 meters; no fading.
NU-8AZY—March 8, 1927; signal strength R2; DC note; interference;
NU-1ZV—March 6, 1927; signal strength R6; very good rectified AC note; interference;
NU-2AFV—March 6, 1927; signal strength R5; very good rectified AC note; interference;
NU-2AKJ—March 26, 1927; signal strength R7-8; good rectified AC note; interference and static;
NU-2CS—March 26, 1927; signal strength R6; DC note; no fading;
NU-8XE—March 24, 1927; signal strength R7-8; unsteady rectified AC note;
NU-1AL—March 13, 1927; signal strength R3; interference; fading;
NU-2CYX—Feb. 2, 1927; signal strength R5; good rectified AC note; no fading;
NU-2RG—Feb. 2, 1927; signal strength R3; good rectified AC note;
NU-8CCM—Feb. 22, 1927; signal strength R2; rectified AC note; interference and static;
NU-1QL—Feb. 22, 1927; signal strength R4; rectified AC note; static;
NU-1BDW—Feb. 27, 1927; signal strength R2-3; atmospherics; fading;
NU-9CPM—March 5, 1927; signal strength R5; good rectified AC note on 30 meters; no fading.

THE following stations were received and logged at the amateur station EF-8NOX, Paris, France, using a Schnell receiver with one stage of audio and a single-wire antenna:

NU-3CKL—March 30, 1927; signal strength R7-8; very good rectified AC note on 39 meters; no fading;
NU-4OY—April 3, 1927; signal strength R5; good DC note on 39 meters; bad interference;
NU-1KK—April 25, 1927; signal strength R5-7; good DC note; no fading;
NU-1ASA—April 3, 1927; signal strength R6; DC note on 41 meters;
NU-8ACU—April 27, 1927; signal strength R5; rectified AC note on 36 meters;
NU-8AFQ—April 4, 1927; signal strength R5; DC note on 38 meters; slight fading;
NU-8DRJ—March 30, 1927; signal strength R6; steady AC note on 41 meters;
NU-5OA—April 27, 1927; signal strength R6; steady DC note on 37 meters;
NU-4TZ—Feb. 9, 1927; signal strength R6; DC note on 38 meters;
NU-8ALY—March 23, 1927; signal strength R6-7; very fine DC note on 38 meters; interference;
NU-8BBE—Feb. 6, 1927; signal strength R7; steady DC note on 41.5 meters; slight interference;
NU-8CCQ—Feb. 4, 1927; signal strength R3; rectified AC note;
NU-8ES—March 25, 1927; signal strength R5; rectified AC note on 41 meters; slight fading;
NU-1AJX—March 5, 1927; signal strength R6; DC note on 39 meters; slight interference;
NU-1AKR—March 4, 1927; signal strength R5; steady rectified AC note on 43 meters; slight interference;
NU-1AXA—Feb. 5, 1927; signal strength R7; good DC note on 39 meters;
NU-1AVF—Feb. 5, 1927; signal strength R6; rectified AC note on 42.5 meters; slight interference;
NU-1ALS—Feb. 7, 1927; signal strength R3; steady rectified AC note on 35 meters;
NU-2QU—March 11, 1927; signal strength R7; very good rectified AC note on 43 meters;
NU-2MD—March 5, 1927; signal strength R6; DC note on 42 meters; slight interference;
NU-2CVS—March 4, 1927; signal strength R5; DC note on 42 meters; slight interference;
NU-2BM—Feb. 2, 1927; signal strength R8; good rectified AC note on 42 meters; slight interference;
NU-2AVB—March 5, 1927; signal strength R5; rectified AC note on 43 meters;
NU-1XM—Feb. 9, 1927; signal strength R7; rectified AC note on 39 meters; slight interference;
NU-1NL—March 6, 1927; signal strength R5; rectified AC note;
NU-1KK—Feb. 7, 1927; signal strength R7; DC note on 38 meters; slight interference;
NU-1IC—Feb. 10, 1927; signal strength R6; rectified AC note;
NU-1GR—Feb. 6, 1927; signal strength R6; DC note on 41.50 meters; slight interference;
NU-1DI—March 4, 1927; signal strength R7; rectified AC note on 38 meters;
NU-1CX—March 8, 1927; signal strength R6; DC note on 42 meters.

FERRANTI A. F. 4 TRANSFORMERS

Exclusively specified

for the

Magnaformer

9-8 Circuit

FERRANTI

A. F. 4. Price $8.50	A. F. 3. Price $12	Output Price $10
Ratio 3½ to 1	Ratio 3½ to 1	Ratio 1 to 1
Dimensions 2¼" x 3" x 3¼"	Dimensions 2¼" x 3" x 3¾"	Dimensions 2¾" x 3" x 3¾"
Weight 1 lb. 3 oz.	Weight 1 lb. 14 oz.	Weight 2 lbs. 10 oz.

Ferranti design
characteristics and construction
assure the highest degree of audio amplification

FERRANTI, INC.
130 West 42nd Street, New York, N. Y.

FERRANTI, LTD.
Hollinwood, England

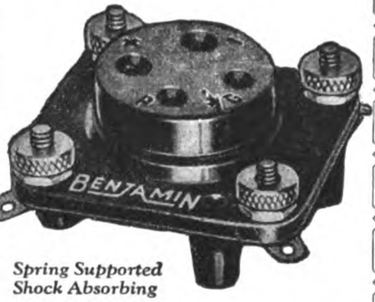
FERRANTI ELECTRIC, LTD.
Toronto, Ontario, Canada

BENJAMIN
TRADE MARK

Cle-Ra-Tone Sockets and Brackets

are specified for the

Magnaformer
9-8 Circuit



Spring Supported
Shock Absorbing

USED the world over by set builders who know and want the best.

Stop tube noises. Anti-microphonic. The greatest contribution to the non-noisy operation of the set.

Tube "floats" on finely tempered springs. One-piece terminal to tube connection. Knurled nuts for binding post connections or handy lugs for soldering.

The choice for practically every prominent circuit for several years. Among the most recent hook-ups for which it has been specified are:

- **Magnaformer 9-8**
- **Camfield Super-Selective 9**
- **Lynch Suppressor Circuit**
- **H.F.L. Nine-in-Line**
- **World's Record Super 10**
- **Strobodyne 8**
- **Melo Heald Fourteen**
- **St. James Super**
- **Two-Dial Equamatic**

Benjamin Shelf Bracket

An aid to simplification in set construction. Support sub-panel, with room underneath for accessories and wiring. Plain and adjustable.

At all Radio Jobbers and Dealers

Made by
Benjamin Electric Mfg. Co.
120-128 S. Sangamon St., Chicago

247 W. 17th St.
New York

448 Bryant St.
San Francisco

Manufactured in Canada by the Benjamin Electric Mfg. Co. of Canada, Ltd., Toronto, Ontario

---

Build One of These Three Great Circuits

Magnaformer
AERO-SEVEN
LC-28

In presenting the constructional details of the Magnaformer, the Aero-Seven and the LC-28, POPULAR RADIO feels that it is continuing what has become a traditional policy to supply its readers with information concerning circuits that represent the best and most advanced practice of modern radio engineering. The Laboratory Staff of the magazine feels that it can conscientiously recommend the construction of either one of these receivers without fear of unfavorable responses. This it does only after thorough investigation in what is, without doubt, the most finely and elaborately equipped magazine laboratory in the world.

In one of these three circuits every reader will find his ideal, both in performance and price. No exaggerated claims have been made and careful construction will reward the builder with more than modest performance.

Readers should remember that the POPULAR RADIO Technical Bureau will be glad to assist them in any problem arising in the operation of these receivers.

POPULAR RADIO, Inc.
627 West 43rd Street
New York City

Specified by L. M. Cockaday for the
Magnaformer
9-8 circuit

Permanent Accuracy!

AEROVOX Fixed Mica Condensers stay accurate because they are moulded in genuine Bakelite and are sealed and protected against possible injury, moisture or chemical action.

A special process in the manufacture of the condenser element enables us to manufacture and guarantee them to be within 10% of their marked rating.

AEROVOX
70 Washington St., Brooklyn, N. Y.

FROST-RADIO
EXCLUSIVELY SPECIFIED FOR THE

Magnaformer
9-8

THE following FROST-RADIO parts are *exclusively* specified for the Magnaformer 9-8, "Commander-in-Chief of the Air." Your dealer can supply you with these parts. Secure them from him today.

FROST-RADIO PARTS FOR THE MAGNAFORMER

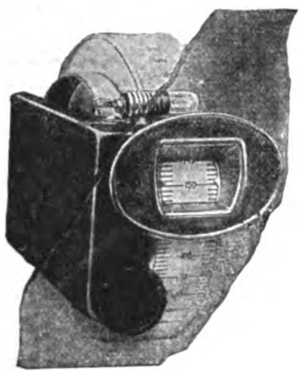
1 No. S-1810 De Luxe 10-ohm Bakelite Combination Rheostat and Battery Switch, gold arrow knob.
1 No. 1824 De Luxe 400-ohm Bakelite Potentiometer, gold arrow knob.
1 No. 1810 De Luxe 10-ohm Bakelite Rheostat, gold arrow knob.
1 No. 1830 De Luxe 30-ohm Bakelite Rheostat, gold arrow knob.
4 No. 253 Frost Cord Tip Jacks.

HERBERT H. FROST, Inc.
Main Offices and Factory
ELKHART, IND.

Chicago
New York
Boston
Philadelphia
Los Angeles

Washington, D. C.
Pittsburgh
New Orleans
St. Paul
Buenos Aires

REMLER RADIO PARTS



Drum Dial.

The Remler Drum Dial gives a full 15 inches of dial space, divided into 200 divisions—2 for each broadcast channel. Calibration strips are rigidly mounted, yet easily removable and renewable. Call letters are readily written in. Socket and 6-volt lamp furnished for illumination. Easily mounted, round drilled hole required for panel plate. Right or left-hand mounting. Calibration strips supplied for either clock-wise or counter clock-wise rotation of dial.

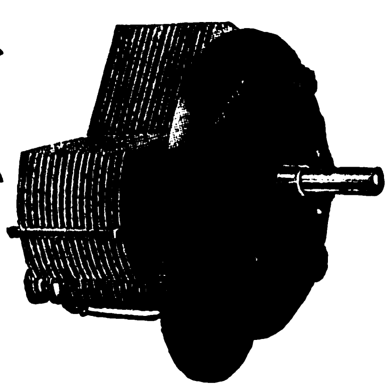
No. 110.—Drum Dial..$4.50

Specified in the

Magnaformer Circuit

because they have demonstrated their superiority in actual use under all conditions.

A new two-color folder, describing and illustrating the entire Remler line of quality radio parts will be mailed free on request.



Twin-Rotor Condenser

Rotation of the dial through a full 360° gives greater separation of stations at all wave lengths than is possible with the usual 180° dial. The dial shaft is completely insulated from the plates, allowing the dial to be grounded and completely eliminating body capacity effects.

Twin Rotor Condenser $5.00

REMLER

Division of

Gray & Danielson Manufacturing Company

Chicago
260 First Street, San Francisco
New York
Eastern Warehouse
Elkhart, Indiana

ALL Magnaformer PARTS IN STOCK

We can furnish you with complete kit of parts for the famous MAGNAFORMER 9-8 Receiver—just as described in construction article in this issue.

WHOLESALE DISTRIBUTORS

We are wholesale distributors for the New Tyrman "10" Receiver, the 9 in Line, Worlds Record Super and all other popular kits.

FREE New 1928 Catalog

Write today for our new 1928 Catalog. It's free to Dealers and Professional Set Builders. Contains list of parts for the above mentioned kits and for all other popular hook-ups. This new catalog includes the newest parts and complete lines produced by Silver-Marshall, Karas, Carter, Aero Coil and describes everything worth while in radio.

SERVICE

We can deliver any kit or part same day order is received. Complete stock on hand, ready for immediate shipment. No delays. Write today for new catalog and revised list of prices.

Prompt Service—No Substitutes

MILLER-WELLES CO.
18A—W. Kinzie St.
Chicago

NATIONAL

TONE FILTER

is exclusively specified for the

Magnaformer

9.8 CIRCUIT

THIS is a power tube output device for preventing the flow of direct current in the winding of the loud-speaker, thereby protecting it from burning out and improving the quality of its tone. A device of this kind is specified by R. C. A., and all other power tube manufacturers.

Price, NATIONAL Tone Filter, with 5 foot phone-cord for instant attachment to any existing set, $7.00. Price without cord, $6.50.

NATIONAL CO., INC. W. A. READY, Pres. Malden, Mass.

Makers of B-Power Supplies, Power Amplifiers, National Tuning Units, National Chargers, etc.

Send for Bulletin L-9

Google

First in the Field Specializing in Cockaday Kits

S. HAMMER RADIO CO.

303 Atkins Ave., Brooklyn, New York

Cockaday Sets Now Made Easier to Build by Our New "Ready-to-Wire" Plan

50% of Your Time, Work and Worry SAVED!

All you need do is to connect bus-bar according to diagram, solder and your set is finished. These Kits are sent to you completely mounted, and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved. Genuine parts used as listed below; exactly as used in Mr. Cockaday's Laboratory Model. COMPARE OUR OFFER!

Magnaformer 9-8 Circuit

1	Formica Front Panel, 7x26x3/16"	$6.50
1	Formica Sub-Panel, 9x25x3/16"	6.50
5	Magnaformer Transformers, Unit R. F. No. 61 @ $8.50	42.50
1	Unicoupler, Unit C. U. No 71	6.50
2	Remler Universal Drum Type Dials with Controls, No. 110 @ $4.50	9.00
2	Remler .0005 mfd. Variable Condensers No. 639 @ $5.00	10.00
9	Benjamin Sockets No. 9044 @ 50c	4.50
2	Benjamin Sub-Panel Brackets, 2" high, No. 8629	.70
2	Ferranti Audio Transformers, A. F. No. 4 @ $8.50	17.00
1	National Tone Filter	7.00
1	Samson Radio Frequency Choke Coil No. 125	2.25
2	Aerovox .00025 Grid Condensers, Type 1475, with Mountings @ 40c	.80
1	Aerovox .001 Fixed Condenser, Type 1450	.40
1	Aerovox 1 mfd. By-pass Condenser, Type 200, Short	.90

2	Durham 2 megohm Grid Leaks @ 50c	$1.00
1	Frost De Luxe 400-ohm Potentiometer, gold arrow knob No. 1824	1.25
1	Frost De Luxe 10-ohm Combination Rheostat and Battery Switch, gold arrow knob No. 81810	1.35
1	Frost De Luxe 10-ohm Rheostat, No. 1810	1.00
1	Frost De Luxe 30-ohm Rheostat, No. 1830	1.00
4	Frost Tip Jacks, No. 253, @ 30c per pair	.60
2	No. 112 Amperites, with Holders @ $1.10	2.20
1	Yaxley Cable Connector Plug No. 660	3.00
1	Yaxley Radio Jack Switch No. 60	1.25
12	Feet Acme Bus Bar Wire No. 14, round tinned, @ 2c foot	.24
25	Feet Acme Flexible Spaghetti covered wire	.95
1	⅝x⅝x2" wood block for sub-panel center support	—
2	2" right angle supports for supporting rear of sub-panel	.10
	Wire, screws, lugs, nuts, bolts, solder	.50

READY-TO-WIRE KIT, PRICE $128.99

DE LUXE QUALITONE LOOP $12.50

AERO-SEVEN Receiver

1	Aero Seven Foundation Unit	$12.00
1	Aero TRF Kit, Code U-12 (3 coils)	12.00
1	Aero Choke No. 60	1.50
1	Silver-Marshall Drum Dial	3.00
1	Carter Battery Switch D	.65
1	Carter 200-ohm "Imp" Potentiometer	1.25
1	Carter 6-ohm "Imp" Rheostat	1.00
1	Carter H-1,000 Resistor	.30
1	Carter H-1 Resistor	.25
1	Carter .00025 mfd. Condenser with clips	.50
1	Carter .001 mfd. Condenser	.50
2	Carter ½ mfd. By-pass Condensers	1.80

10	XL Binding Posts	$1.50
1	Amsco Floating Socket	1.00
6	Amsco Plain Sockets, 50c each	3.00
1	Amsco .0005 mfd. Triple Condenser	11.25
1	Amsco Grid Gate Mounting	.30
1	Amsco 5 meg. Grid Gate	.50
1	Kit AMSCO Aero Seven Resistance Coupled Audio	7.00
	Screw assortment and bus bar	.25

READY-TO-WIRE KIT, PRICE $59.55

NEW! COCKADAY LC-28 RECEIVER

4	Hammarlund Mid-Line Variable Condensers, .000275 mfd. @ $5.10	$20.40
1	Hammarlund Double Drum Dial	6.00
1	Set of Precision Radio Frequency Transformers, type 4-B	12.50
3	Samson High Frequency Chokes, type No. 125, @ $2.25	6.75
1	Samson High Frequency Choke, type No. 85	2.00
3	Aerovox Moulded Condensers, .02 mfd., @ $1.50	4.50
1	Aerovox Moulded Condenser, .00025 mfd.	.35
1	Aerovox Moulded Condenser, .00075 mfd.	.40
1	Yaxley Combination Switch and Rheostat, 6 ohms, No. 906-K	1.75
1	Yaxley Cable Connector Plug with Cable, type 660	3.00
4	Carter Fixed Resistance 4 ohms, type H-4, @ 25c	1.00

2	Carter Imp. Plugs and Tip Jacks, marked "antenna" and "ground," respectively, with insulating washers for antenna jack @ 25c	$0.50
4	Benjamin Vibrationless Sockets @ 75c	3.00
1	Lynch Single Resistance Mountings	.35
1	Lynch Suppressor, 500 ohms	1.50
1	Lynch Suppressor, 600 ohms	1.50
1	Lynch Suppressor, 700 ohms	1.50
1	Durham Metallized Resistor, 6 meg	.50
2	Tait Brackets	2.00
1	Alcoa Aluminum Chassis	7.50
4	Sets Special Aluminum Box Shields for LC-28 @ $2.00	8.00
1	Aluminum Panel, 6"x26"	4.00
1	¼" Extension Shaft	.50

READY-TO-WIRE KIT, PRICE $89.50

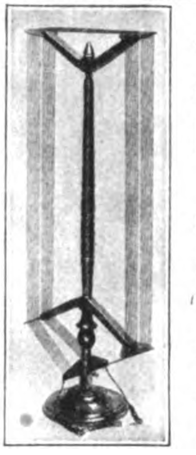
POWER PACK and AUDIO AMPLIFIER

to operate in conjunction with the LC-28 Receiver—in Stock!!

NEW HAMMARLUND ROBERTS HI-Q SIX

Write for Special Circular which we have prepared on the above Kits

DEALERS: **Send for our 1928 Catalog—now ready! Write for it NOW!**



QUALI-TONE "DE LUXE"

Is Exclusively Specified for the

Magnaformer

9-8 Circuit

RECOMMENDED By Leading Radio Authorities

And specified for exclusive use with the World's Record Super Receivers, the 9 In Line, Melo Heald, Victoreen, St. James, Popular Mechanics Economy Nine, and many other receivers.

BECAUSE

The Quali-Tone is the only loop that can claim two world records—brought in **stations 6000 miles distant, and most consistant reception of far distant stations. In the Quali-Tone De Luxe, construction is of the highest quality throughout. Woodwork is of selected, solid walnut, hand rubbed, natural finish. Only the finest grade of stranded wire, well insulated and covered with brown silk braiding is used. Wire spacers are made of best grade insulating material, reducing losses to a minimum. Every Quali-Tone Loop has the special patented Quali-Tone adjustment which keeps the wires taut always. Three leads are furnished, the center tap being removable.**

Compare the Quali-Tone construction, design and performance, and you will find that it excels in every particular. It incorporates every loop improvement and is flawless throughout. The De Luxe model turns within a radius of 5½ inches—the Quali-Tone within a radius of 7½ inches. All Quali-Tone Loops are designed for use with .0005 condensers. Try the De Luxe for the finest reception.

The Quali-Tone De Luxe	**$12.50**
The Quali-Tone	**10.00**

Jobbers Dealers

The Quali-Tone Loop is not an experiment. For two years it has been the fastest selling loop on the market—due entirely to its exceptional merit and the improved results it guarantees. Order today or write for circulars.

DURO METAL PRODUCTS CO.
2655 N. Kildare Avenue Chicago

Operating Data

for the

Magnaformer

AERO-SEVEN

and

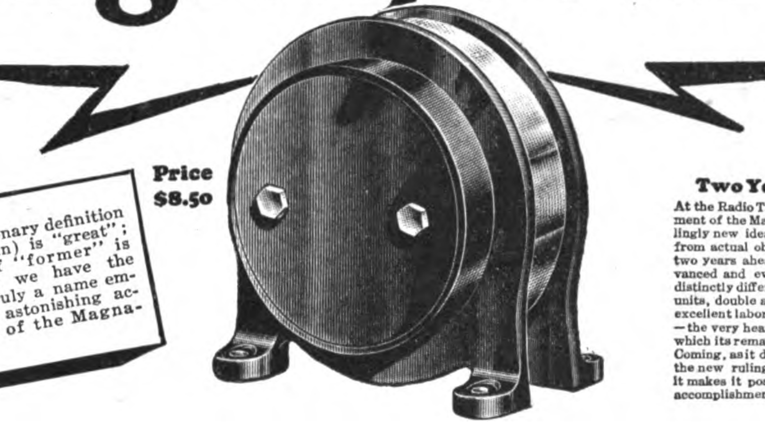
LC-28

Will be found in the forthcoming issues of POPULAR RADIO. Let the radio engineers who designed these remarkable circuits tell you how to operate them for the most gratifying results. Following the individual series will allow the builders of these already famous receivers to get maximum results in minimum time. Disappointment at the newsstand can be avoided by entering your subscription to POPULAR RADIO now.

Subscription Department

POPULAR RADIO, Inc.
627 W. 43rd St., New York City

Magnaformer



Price $8.50

Magna—The dictionary definition of "magna" (Latin) is "great"; the definition of "former" is "creator". Thus, we have the Great Creator, truly a name emblematic of the astonishing accomplishments of the Magnaformer.

Two Years Ahead in Design

At the Radio Trade Show in Chicago, the announcement of the Magnaformer was one of the few startlingly new ideas in radio development. We know from actual observation that the Magnaformer is two years ahead in design, for it incorporates advanced and evolutionary ideas throughout. It is distinctly different, with its self-shielding, matched units, double amplification for each R. F. stage and excellent laboratory construction. It is a fresh idea—the very heart of the new and better receiver in which its remarkable qualities are given full range. Coming, as it does, when the air has been cleared by the new rulings of the federal radio commission, it makes it possible to secure exceptional results, accomplishments heretofore unknown to radio fans.

THE new Magnaformer 9-8 Receiver has won the instant approval of radio experts. It has created a new standard of all-around radio efficiency. It is the season's feature circuit in Radio, Citizens Radio Call Book, Popular Radio, and other well-known magazines. This widespread acceptance and enthusiasm is due to the inherent excellence of the circuit—its hair-splitting selectivity, perfected, superb tone, great volume and extremely long range. During the first test of the Magnaformer Receiver this Spring, 43 D-X stations were logged from Chicago, including three on the Pacific Coast. The engineers present during the test were astounded. Subsequent performances have shown that the Magnaformer does the amazing thing consistently. Winter reception will see many additional record performances, according to the experts. The enthusiastic reception accorded in Chicago is now being given the Magnaformer the country over. Its performance is sensational. It is the talked-about circuit in radio professional and amateur circles. One of the real thrills and joys in truly exceptional radio performances is in store for the man who "builds his own," and it is impossible to duplicate the work of the Magnaformer in any other way.

The secret of the Magnaformer circuit's efficiency lies in the new Magnaformer intermediate long-wave transformers with which it is equipped. These transformers are a distinct innovation in radio. They are refreshingly new in design, in workmanship and in performance. This new and superior construction meets the present-day demand for greater radio efficiency, a demand far more critical than ever before, due to radio's rapid advancement in factory-built receivers. The circuit throughout is new and modern. It has the latest lighted drum dials, controlled by knobs instead of the fingers; unique Ferranti transformers give equal amplification of all audio frequencies; output tone filter insures retention of tone quality.

Thus, in the Magnaformer you have a precision-built instrument that ranks foremost in laboratory circles and which is available to set builders in the perfection of a truly remarkable radio receiver, a receiver that is designed from the best available parts possible to produce, all matched perfectly into a compact, high-quality receiving set of the first order.

Truly, it has well earned its name, Magnaformer, the *"Great Creator."*

Magnaformers are different, outstanding and unusual in four vital respects

FIRST—Magnaformers are precisely and unalterably tuned in the laboratory to exactly the same wave length in such a manner that they always positively pass the full and complete signal-wave with all of its harmonic carrying side-bands intact; result—surprisingly beautiful tone quality.

SECOND—The combined elements of technical engineering design of Magnaformer Intermediates are such that the incoming signal receives double the usual amplification in each R. F. stage; result—a very powerful output perfectly controlled from a whisper to volume enough to fill a large hall—every sound clear and distinct.

THIRD—Magnaformers are thoroughly and scientifically shielded—so that the tubes to which they are connected will not oscillate, no matter how closely together or in what position they are placed in the receiver—a very important factor of its superior design; result—no fuss, no fuming, no squeals, squawks, blurps nor hisses. Just beautiful, natural reception, clear, full-toned, quiet, powerful.

FOURTH—Mechanically, Magnaformers are as nearly perfect as engineering skill can make them. The three foregoing electrical factors are dependent on perfection of Mechanical Design to insure their unvarying performance. The primary and secondary coils of each Magnaformer are wound on pure Bakelite and are permanently fixed so that their inductances cannot possibly change. The secondary inductances are exactly tuned in the laboratory by small variable condensers which are fixed and locked after the tuning is done. These small condensers are locked in entirely separate Bakelite compartments and are ENTIRELY outside the electrostatic fields of the coils. No jar or jolt can disturb or change the inductances or capacities of Magnaformers after they leave the laboratory. The coils also are locked in entirely separate Bakelite compartments. Both coils and condensers are specially treated before being locked in their separate compartments. They cannot possibly be affected by moisture, atmospheric or climatic changes; result—a permanency of vital tuning factors that insures a uniform and unalterable reception for the Receiver, year in and year out—a rare achievement.

Permanent, Unalterable, Fixed Construction

The size, the shape, the built-in quality features—these three elements incorporated in the Magnaformer intermediate transformer, makes it surprisingly efficient and practical.

It is the best-balanced, most critically adjusted and fixed unit that can be had. It is the correct size for ease in handling and mounting side by side. It is the one unit in a radio set upon which the performance of everything else is dependent. Therefore, it is constructed with precision, exactness and fixed, adjusted and sealed in manufacturing to insure perfect operation continuously. It will never need adjustment, taking apart or tinkering. It is as fixed and final when it reaches you as anything can be.

It is fool-proof and trouble-free—features that will be appreciated by both the amateur and experienced set builder.

An Appreciation to the Set Builder

We take off our hats to the set builder, the man who has really made radio what it is today. Without set builders—the makers of custom-built receivers, the science of radio would still be in the infant stages. The inspirations, the innovations, the continuous streams of new ideas, advancement and accomplishment in radio—these are all due to the set builder. It was the set builder who was the first to recognize radio's possibilities. It is to his untiring zeal that radio is what it is today.

The set builder deserves the respect of every professional radio engineer and manufacturer in the industry.

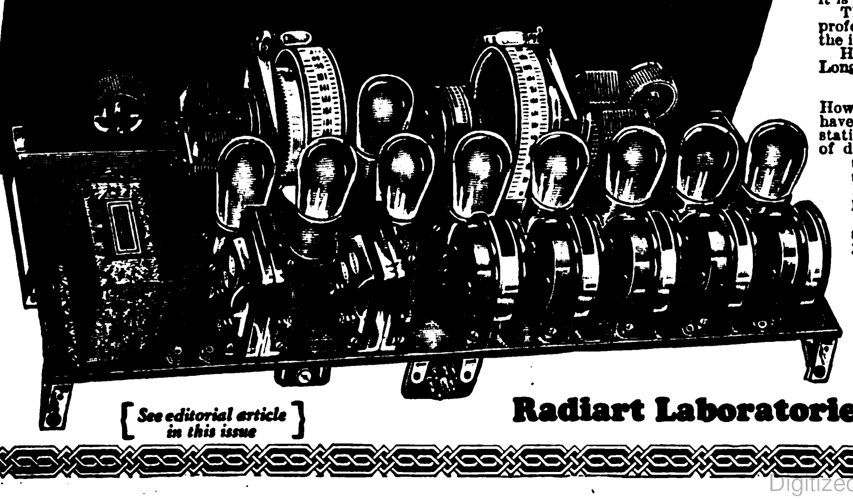
Here's to the Knight of the soldering iron! Long may he carry on!

Enjoy This Thrill!

How many times have you wished that you could have a radio set that would bring in almost any station you desired, loudly and clearly, regardless of distance, and without squeals and howls? A set you could operate with perfect ease? A set that reproduces naturally, sweetly, delightfully, just as if you were listening to the program in the studio?

Now the opportunity to actually hear the supreme achievement in radio is afforded to you through the Magnaformer. It will be a new and pleasing experience for you and will furnish you with a new and novel radio thrill.

10c brings you full-size visualized circuit blue-prints, novel wiring diagram, complete wiring instructions and detailed story of development and accomplishments of Magnaformer. Be the first to get it.



[*See editorial article in this issue*]

Radiart Laboratories Co. 19 S. LaSalle St., Dept. 46
CHICAGO, ILLINOIS

30 Days FREE TRIAL

Single Control 7-Tube

$77

RETAIL PRICE

Completely Assembled

The Randolph

SINGLE CONTROL — ILLUMINATED DRUM

POWERFUL seven-tube radio at factory price. Test it without spending a cent. We claim the Randolph Seven will out-perform any radio and we want you to satisfy yourself that it will. To do this, we will send you this powerful radio to try for 30 days. Test it for distance, clearness, ease of operation, tone and every other way you can. Unless it more than satisfies you, return it to us. **Every Randolph set must make good before it is sold.**

Battery or ALL ELECTRIC OPERATION

The Randolph Seven is sold for use with batteries or connected for operation direct to electric light socket—absolutely batteryless—no chargers or batteries—just **plug in** socket and **tune in.** 100% efficient either way. Its construction and performance have been tested and approved by leading radio engineers and authorities and leading radio and scientific publications.

Single Control—Illuminated Drum

One drum dial operated by one simple vernier control tunes in all stations with easy selectivity to tremendous volume. No overlapping of stations. Illuminated drum permits operation in the dark. Volume control for finer volume modulation. This is a 7-tube tuned radio frequency receiver with power transformers and power amplification. Space wound solenoid coils Full and completely shielded. A real receiver of the highest quality. Tremendous distance, wonderful tone quality, simple to operate.

The Randolph cabinets are in themselves beautiful pieces of furniture made of carefully selected solid burl walnut. Bas-relief bronze escutcheon plates are mounted on the dial panel. In design and appearance it is a cabinet worthy of the high-quality radio it contains. Solid walnut beautifully shaped surrounds the soft verdi-green panel.

Nothing has been spared to make the Randolph Seven the leading radio receiver. We are so sure that it will surpass even your best hopes that we know how safe we are in making the **30 day free trial offer.**

Read What Owners Say

I have logged more than 50 stations from coast to coast.—Lloyd Davenport, Littlefield, Texas.

I have logged 52 stations from Cuba to Seattle—the set is a world beater.—J. Tampkinson, Detroit, Mich.

Your set is a revelation—has all others tied to the post for distance and selectivity.—Waldo Powers, Vergennes, Vermont.

On strength of its performance sold two more sets this week. T. Scanlow, Orlando, Florida.

Beautiful Ampliphonic Console Set

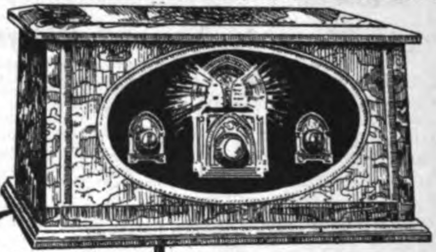
Made of the finest carefully selected solid walnut. Two-tone shaded finish. Has built-in cone loudspeaker that compares with any on the market and accurately reproduces high and low notes. Send for the folder today that shows this beautiful console in full colors and gives complete details. **Compares with most table sets in price.** For **battery** or **all-electric operation** ready to **plug in** and **tune in.** Write for complete descriptions.

Randolph Radio Corporation

711 W. Lake St. Dept. 56, Chicago, Ill.

BIGGEST DISCOUNTS to AGENTS and DEALERS

WORK either full or part time and make big money. Tremendous advertising campaign helps you sell. Regardless of whether you have ever sold before, be sure to get our proposition. The Randolph sells on first demonstration. Men and women both can make money this easy way. Get your demonstration set for thirty days FREE TRIAL.



6-Tube

$55

Retail Price

SINGLE CONTROL

The Randolph

Now you can have a **new, modern, single-control, six-tube radio.** Do not compare this set with old style 2-dial 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers.

Comes in a beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated Drum with space for logging. Absolutely dependable and very selective. **Sent for 30 Days Free Trial. You test it before you buy.**

Mail Coupon Now

The Randolph Radio Corporation are pioneers in the manufacture of radios. All of its vast and unlimited resources have been used in making and perfecting of the Randolph Receivers. Because of our long and successful experience in the radio business, we are perfectly confident in sending out a Randolph Radio on trial. We know what it will do. Mail us the coupon now for the greatest radio offer ever made.

USE THIS COUPON TODAY!

Randolph Radio Corporation,
711 West Lake Street, Dept. 56
Chicago, Illinois.

Send me full particulars about the RANDOLPH Six and Seven-Tube Table and Console Sets with details of your **30 Day FREE Trial Offer.**

Name..

Address..

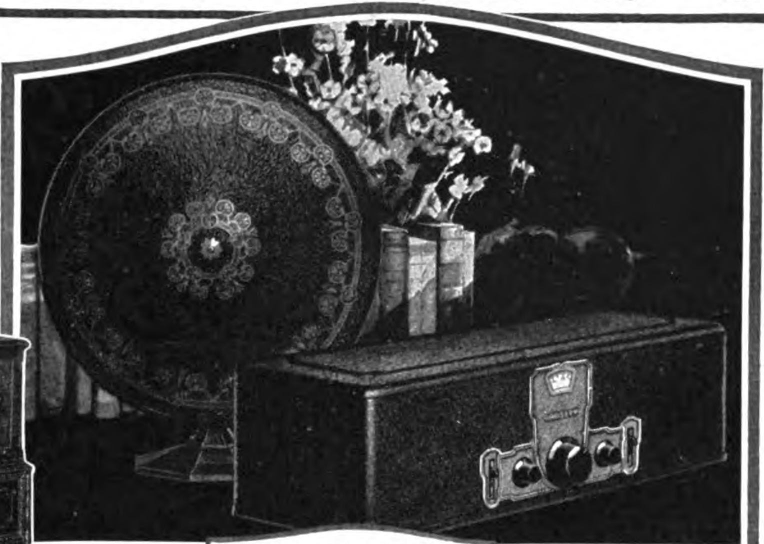
City.. State..........................

Mark here ( ) if interested in Agent's proposition.

"....You're *there* with a Crosley"

$35

$85



The BANDBOX $55
A 6 tube Receiver
Brown frosted Crystalline finish—Bronze Escutcheon.

$65

These approved cabinets have been selected by Powel Crosley, Jr., as ideal consoles, acoustically and mechanically, for the installation of the Crosley "BANDBOX." Genuine Musicones built in. Crosley dealers secure them from their jobbers through

H. T. ROBERTS CO.
914 S. Michigan Ave.
Chicago, Ill.

Sales Agents for Approved Console Factories:
SHOWERS BROTHERS COMPANY
THE WOLF MFG. INDUSTRIES

A tremendous Crosley Radio achievement *for* 1927-28

Recent court decisions which clarified the radio patent situation have paved the way for still greater Crosley triumphs.

Now—completely available to Crosley—and amplifying Crosley supremacy in fullest measure, are the enormous resources, great discoveries and ideas embodied in patents of

1—The Crosley Radio Corporation.
2—The Radio Corp. of America.
3—The Westinghouse Co.
4—The General Electric Co.
5—The American Telephone & Telegraph Co.
6—The Hazeltine Corporation.
7—The Latour Corporation.

under which Crosley is now licensed to manufacture.

Here are the seven big things which represent radio's greatest advancement, brought together by Crosley and combined with the experience, mass production method and leadership of the Crosley organization. No wonder a waiting radio world pronounces the "Bandbox" at the unprecedented price of $55, Crosley's paramount achievement.

The Bandbox Is Shielded

Radio coils are surrounded by magnetic fields similar in every respect to the magnetic field around the earth that moves the needle of a compass but around radio coils these fields make nuisances of themselves by feeding back on each other. Heretofore it has been customary to make inefficient coils with inefficient fields to prevent such feeding back. The Crosley Bandbox incorporates copper shields around each coil to prevent such feeding back. The coils consequently can be made and are very much more efficient. The amplification of the receiver is, therefore, much higher—the sensitivity is greatly increased. Condensers are also completely shielded from each other in separate metal compartments. Hitherto, only high priced sets have enjoyed this super radio advantage.

There Is No Oscillation

The Bandbox employs completely balanced or neutralized radio frequency stages to prevent oscillation, instead of the common form of losser method. More costly, to be sure, but extremely necessary in achieving such results as are obtained by this marvel of radio reception.

For Sharpness--The Acuminators

"Bandbox" acuminators enable "fishers" for distant stations to bring them in loud and clear. As powerful telescopes magnify distant scenes, acuminators increase the volume of far-a-way signals so they seem like local programs.

Volume Control

This is another big "Bandbox" feature which permits full brass band power for those who want their dance notes strong and loud. For others, it cuts volume down to a soft and gentle murmur, without distortion.

Illuminated Dial

A Master Station Selector has an illuminated dial for easy reading in shadowy corners. A single knob permits full tuning for ordinary reception of local, nearby and superpowered stations.

Installation Simplified

A woven cable, containing vari-colored rubber covered leads, makes installation and hook-up easy for the veriest novice. No waiting for the radio service man, should the batteries be changed.

Easily Adapted to Consoles

Simply remove screws in escutcheon and in base of set. Lift off metal case. Chassis now stands ready for installation in console cabinet. Opening in console cabinet permits control shafts to protrude. Escutcheon screws in place and—Presto! the console radio is complete.

For A C Operation a special Bandbox is available at $65, wired specially for use with the Crosley Power Converter at $60. This special Bandbox utilizes the new R.C.A. AC tubes which have made the operation of radio receivers direct from house current so simple, efficient and dependable. The first three tubes employed in the AC model are UX 226. These go into the radio frequency sockets. The detector tube is UY 227, with indirectly heated emitter. Another UX 226 is used in the first audio stage. Raw AC current heats the filament of all UX 226 tubes. Power tube UX 171 is in the last audio socket. This makes the "dog houses" rumble sonorously and the bass drums deeply boom.

The Power Converter

The power converter which smooths the alternating current is a marvel of engineering ingenuity. Only half the size of an ordinary "A" storage battery, it supplies the required A, B and C currents, without hum. Finished in brown frosted crystalline.

There are models for 25 and 60 cycle current. A snap switch shuts down the set and power converter completely.

Price of Power Converter--$60

You owe it to yourself to see the "Bandbox" and listen to its remarkable performance. If you cannot easily locate the nearest Crosley dealer, his name and address will be supplied on request. Write Dept. 16.

IMPROVED MUSICONES

Although Musicones improve the reception of any radio set, they are perfect affinities in finish, beauty and reproductive effectiveness for Crosley Radios. A new model built in the form of a Colonial Tilt-Table with brown mahogany finish, stands 3 feet high. Price $27.50.

16-Inch Super Musicone
(As pictured with Bandbox)
$12.75

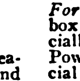
12-Inch Ultra Musicone
$9.75

CROSLEY RADIO

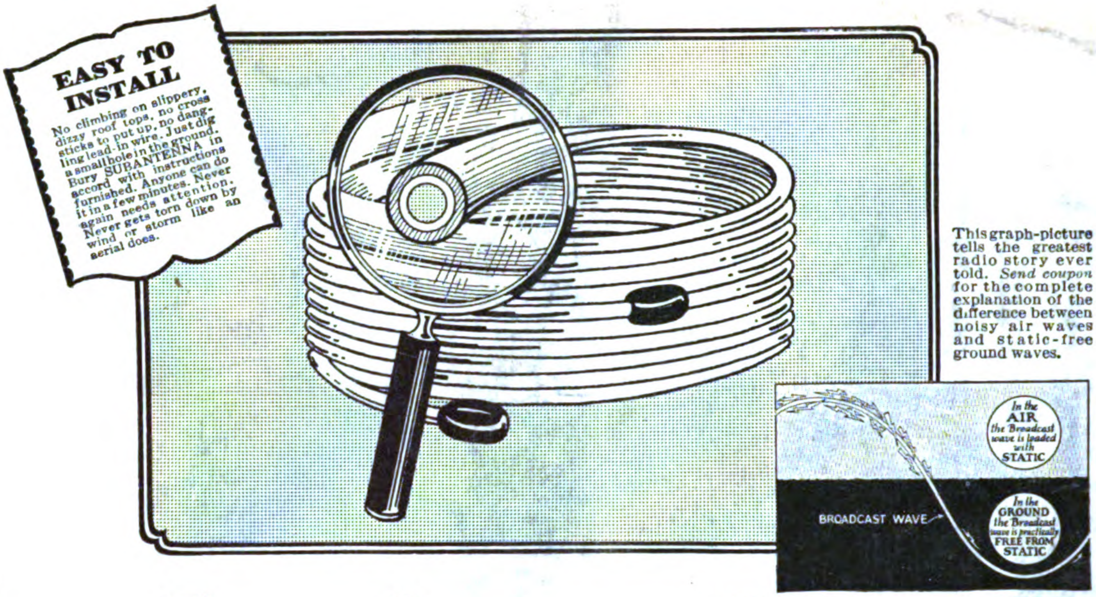
Crosley Radio is licensed only for Radio Amateur, Experimental and Broadcast Reception

NEUTRODYNE

Crosley recommends the use of five 201-A Radiotrons and one UX-171 power tube, or Cunningham equivalents, which are furnished at standard tube prices, with each Bandbox. While Radiotron UX-171 is 180-volt tube, it gives a superior performance for 135-volt "B" batteries.



THE CROSLEY RADIO CORPORATION
POWEL CROSLEY, JR., *Pres.* **CINCINNATI, OHIO**
Prices slightly higher West of the Rocky Mountains


EASY TO INSTALL

No climbing on slippery, dizzy roof tops, no cross sticks to put up, no dangling lead-in wire. Just dig a small hole in the ground. Bury SUBANTENNA in accord with instructions furnished. Anyone can do it in a few minutes. Never again needs attention. Never gets torn down by wind or storm like an aerial does.

This graph-picture tells the greatest radio story ever told. *Send coupon* for the complete explanation of the difference between noisy air waves and static-free ground waves.

In the AIR the Broadcast wave is loaded with STATIC
BROADCAST WAVE
In the GROUND the Broadcast wave is practically FREE FROM STATIC

Oh-the joy of Radio! with a SUBANTENNA

"I get plenty of stations with my Subantenna, on the loud speaker, that I have never been able to reach with my outside aerial. It absolutely cuts down interference to the minimum, **cuts static out, too —not just partly out—but ALL out"**

H. S. M., North Carolina

And besides that he gets stations with his Subantenna that he never could coax out of the air with an aerial! Read what Mr. H. S. M. of North Carolina thinks of Subantenna, in his letter which we have reprinted in brackets at the top of this column. He is just one of many thousands of fans who are enjoying clearer, louder, better long distance radio reception since discarding the unsightly, static-collecting, up-in-the-air type of aerial, and using in its stead, Subantenna, the new *underground* antenna.

Every Night a Good Radio Night —Now an Actuality

Gone is the time when the first warm day is the signal for pushing the radio back in the corner until cold weather comes again. A thing of the past is the disappointment of having an evening's radio fun spoiled by an unexpected storm or attack of static. Install a Subantenna and your radio will be as dependable as the sunrise. On any night, in any season, in any weather you can get real "distance," enjoyable clarity and bigger usable volume than you ever could before —all you need is a Subantenna.

What Scientists Found Out

For years the heads of great laboratories have been trying to perfect a means of tuning static out of radio impulses received from the air. And all this time they knew not only that the same radio wave which travelled thru the air also travelled thru the ground, but that the ground is practically free from static! Knowing this, a group of inventors set out to develop a device by which the radio wave could be satisfactorily picked up from the ground. Result! Subantenna—already tested and proved by thousands of users—and offered to YOU to test on an unconditional, unqualified guarantee basis. Read herewith, a few more of the voluntary letters of praise which Subantenna users have sent in. Then get the whole explanation of Subantenna—why the ground is almost static-free—why Subantenna increases the distance-getting capabilities of practically any set—why it increases volume and improves selectivity. Get this information from your dealer, or mail the coupon from this announcement for booklet and our *free trial* offer. Now, read:

Says its WONDERFUL!

"After 4 years of testing aerials I at last found the master in the Subantenna. The first night I used it was a very hot summer night. Static was very bad on my outdoor aerial. I connected my Subantenna and one could hardly believe the results. It was wonderful."—F. L. C., Mass.

Works Fine with "B" Eliminator

"We have the Subantenna installed and it is all you claim it to be. It works fine and we enjoy it very much. We also have a B Battery Eliminator and the two together work fine. We would not want to go back on the high-in-the-air aerial again as we get so much better reception on Subantenna."—A. J. L., Maine.

SURPRISED!

"I received the Subantenna and installed it the same night and believe me I was surprised with the result for I was quite suspicious about it. I am well satisfied."—R. E. G., Canada.

FREE TRIAL

Make This Convincing Test

Install SUBANTENNA. Leave your old aerial up. Select a bad night when DX is almost impossible with the ordinary aerial. Make a comparison station for station connecting first your aerial, then SUBANTENNA. If, from stations that are just a mess of jumbled noise with the old aerial, you don't get reception that rivals local in sweetness and clarity the instant you switch to SUBANTENNA, this test won't cost you even a single penny. Obtain a SUBANTENNA from your dealer or send coupon at once for scientific explanation of SUBANTENNA and for particulars of GUARANTEE and FREE TRIAL OFFER. SEND COUPON NOW!

SUBANTENNA

The New Underground Antenna

Made by CLOVERLEAF MANUFACTURING CO.
2715-K CANAL STREET CHICAGO, ILLINOIS

CLIP AND MAIL AT ONCE

CLOVERLEAF MFG. CO.,
2715-K Canal Street, Chicago, Illinois

Tell me all about SUBANTENNA, your unqualified, unconditional guarantee and your FREE TRIAL OFFER.

Name..

Address..

....

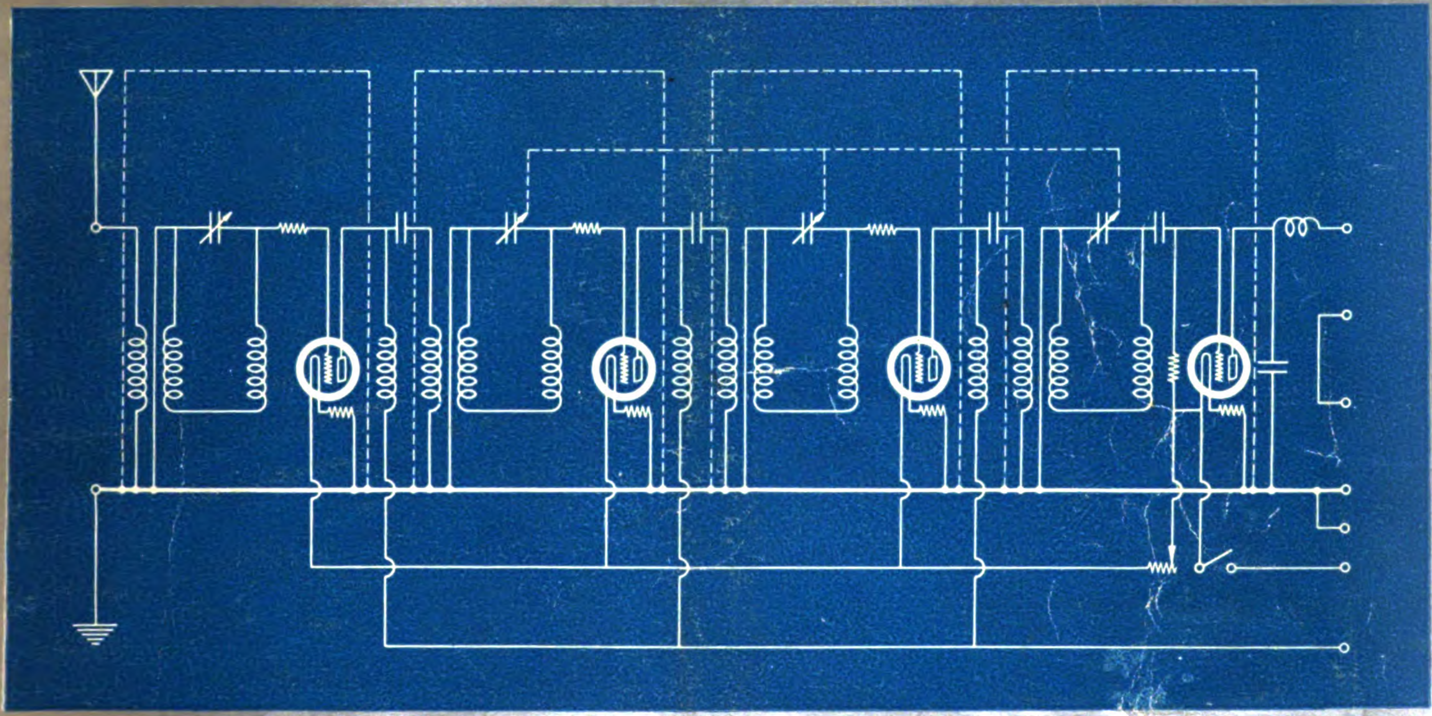
QUADRI-COLOR CO., JAMAICA, N.Y.

Popular Radio

OCT 12 1927

25¢

OCTOBER • 1927



In this Issue —

Complete Constructional Details —
The New LC-28 Receiver *and*
The Magnaformer Superheterodyne

30 DAYS FREE TRIAL

Battery or
All-Electric
OPERATION

HERE is the great value offer of the day. Test and try this powerful seven-tube RANDOLPH RADIO for thirty days. After it **brings in stations from coast to coast** with amazing clearness—**with easy one-dial tuning**—after it **easily equals any other radio** regardless of cost—after you are more than satisfied then you can buy it **direct at factory prices. Every RANDOLPH must make good before it is sold.**

The RANDOLPH SEVEN-TUBE CONSOLE illustrated here can be had for use with batteries or **connected direct to the electric light socket—absolutely batteryless—no batteries, chargers or acids—just plug in and tune in.** 100% efficient either way. Its construction and performance have been tested and approved by leading radio engineers and authorities—by leading radio publications and laboratories.

7 Tubes—Single Control
Illuminated Drum

One drum dial operated by one simple vernier control tunes in all stations with easy selectivity to tremendous volume. No overlapping of stations. Illuminated drum permits operation in the dark. Volume control for finer volume modulation. This is a seven-tube tuned radio frequency receiver with power transformers and power amplification. Space wound solenoid coils. Full and completely shielded. A real receiver of the highest quality. Tremendous distance, wonderful tone quality, simple to operate.

Beautiful Walnut Console
Built-in Cone Speaker

The Randolph Seven-tube Ampliphonic Console illustrated above is housed in a genuine burl-walnut cabinet with two-tone hand rubbed finish giving it unsurpassed beauty. The same expert cabinet work has gone into the making of these consoles as in the finest furniture. Has **built-in cone loud speaker that compares with any on the market.** Accurately reproduces complete range of musical notes from the highest to the lowest pitch.

What Users Say

I have logged more than 50 stations from coast to coast.—Lloyd Davenport, Littlefield, Texas. I have logged 52 stations from Cuba to Seattle, the set is a world beater.—J. Tampkinson, Detroit, Mich. Your set is a revelation, has all others tied to the post for distance and selectivity.—Waldo Powers, Vergennes, Vermont. On strength of its performance sold two more sets this week.—T. Scanlow, Orlando, Florida.

The Randolph
7-Tube Console
Single Control
RETAIL PRICE
Completely Assembled
$99

Sensationally Big Discounts to Agents

Work either full or part time and make big money. Tremendous advertising campaign helps you sell. Regardless of whether you have ever sold before, be sure to get our proposition. The Randolph sells on first demonstration. Men and women both can make money this easy way. Get your demonstration set for thirty day's FREE TRIAL.

MAIL COUPON NOW!

The Senior Six

Now you can have a new, modern, single-control, six-tube radio. Do not compare this set with old style 2-dial 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers.

Comes in a beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated Drum with space for logging. Absolutely dependable and very selective. **Sent for 30 Days' Free Trial. You test it before you buy.**

6-Tube
$55
Retail Price
Single Control

The Randolph Radio Corporation are pioneers in the manufacture of radios. All of its vast and unlimited resources have been used in making and perfecting of the Randolph Receivers. Because of our long and successful experience in the radio business, we are perfectly confident in sending out a Randolph Radio on trial. We know what it will do. Mail us the coupon now for the greatest radio offer ever made.

RANDOLPH RADIO CORPORATION
711 West Lake Street **Dept. 253** **Chicago, Illinois**

Use This Coupon NOW!

Randolph Radio Corporation,
711 West Lake Street, Dept. 253
Chicago, Illinois.

Send me full particulars about the RANDOLPH Six and Seven-Tube All-Electric and Battery Table and Console Sets with details of your **30 Day FREE Trial Offer.**

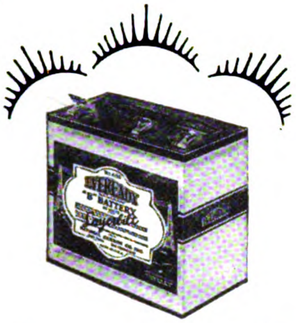
Name..

Address...

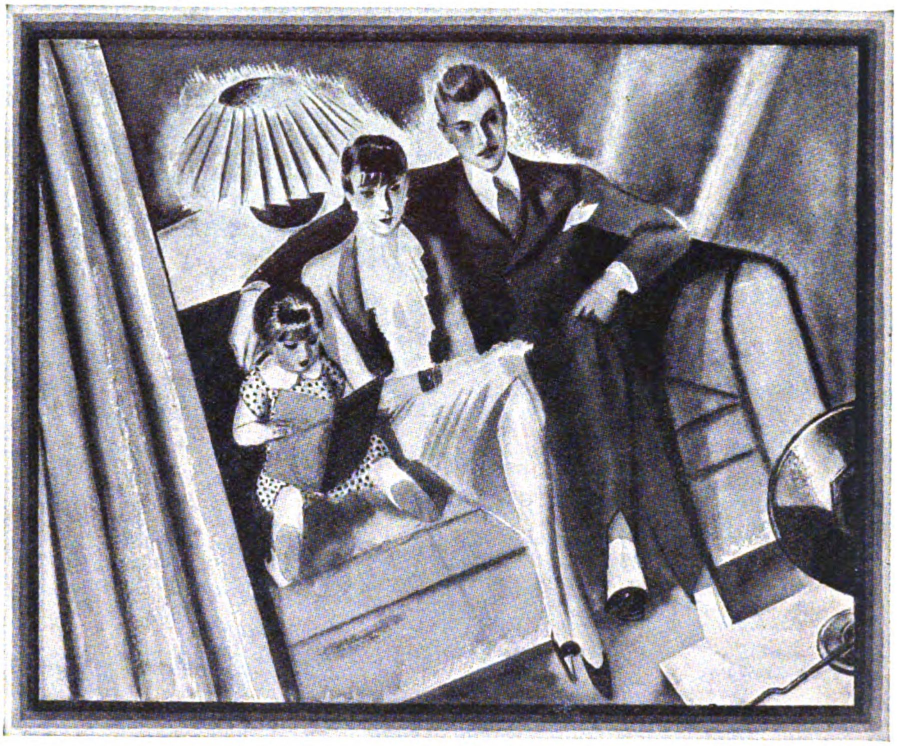
City.. State..................

Mark here ☐ if interested in Agent's proposition.

Restored Enchantment



This is the Eveready Layerbilt that gives you Battery Power for the longest time and the least money.



THERE is no doubt of it—radio is better with Battery Power. And never was radio so worthy of the perfection of reception that batteries, and batteries alone, make possible. Today more than ever you need what batteries give—pure DC, Direct Current, electricity that flows smoothly, quietly, noiselessly. When such is the current that operates your receiver, you are unconscious of its mechanism, for you do not hear it humming, buzzing, crackling. The enchantment of the program is complete.

Batteries themselves have improved, as has radio. Today they are so perfect, and so long-lasting, as to be equal to the demands of the modern receiver. Power your set with the Eveready Layerbilt "B" Battery No. 486. This is the battery whose unique, exclusive construction makes it last longer than any other Eveready. Could more be said? In most homes a set of Layerbilts lasts an entire season. This is the battery that brings you Battery Power with all its advantages, conferring benefits and enjoyments that are really tremendous when compared with the small cost and effort involved in replacements at long intervals. For the best in radio, use the Eveready Layerbilt.

EVEREADY
Radio Batteries
-they last longer

Radio is better with Battery Power

At a turn of the dial a radio program comes to you. It is clear. It is true. It is natural. You thank the powers of nature that have once more brought quiet to the distant reaches of the radio-swept air. You are grateful to the broadcasters whose programs were never so enjoyable, so enchanting. You call down blessings upon the authority that has allotted to each station its proper place. And, if you are radio-wise, you will be thankful that you bought a new set of "B" batteries to make the most out of radio's newest and most glorious season.

NATIONAL CARBON CO., INC. UCC New York—San Francisco

Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time

WEAF—*New York*
WJAR—*Providence*
WEEI—*Boston*
WDAF—*Kansas City*
WFI—*Philadelphia*
WGR—*Buffalo*
WCAE—*Pittsburgh*
WSAI—*Cincinnati*
WTAM—*Cleveland*
WWJ—*Detroit*
WGN—*Chicago*
WOC—*Davenport*
WCCO { *Minneapolis* / *St. Paul*
KSD—*St. Louis*
WRC—*Washington*
WGY—*Schenectady*
WHAS—*Louisville*
WSB—*Atlanta*
WSM—*Nashville*
WMC—*Memphis*

Pacific Coast Stations—9 P. M., Pacific Standard Time

KPO—KGO—*San Francisco*
KFOA—KOMO—*Seattle*
KFI—*Los Angeles*
KGW—*Portland*

Have you heard the new Victor record by the Eveready Hour Group—orchestra and singers—in Middleton's Down South Overture and Dvořák's Goin' Home?

Popular Radio

FOUNDED 1911

VOLUME XII October, 1927 NUMBER 4

CONTENTS

Do Aerial Tides Make Reception Better Under a Full Moon?

FRONTISPIECE..........PAGE 210

The Effect of Moonlight on Reception

An account of an experiment that may have a profound affect on the science of long-distance communication by radio

By Derek Shannon, F.R.S.A.....PAGE 211

How to Build the LC-28 Receiver

The full constructional details for POPULAR RADIO'S latest and best contribution to the radio art—a high-frequency pack that cannot be excelled in quality amplification, efficient and long-lived service and ease of construction

By Laurence M. Cockaday....PAGE 214

How to Add to Your Old Phonograph the New Amplification Units

The third of a series of articles that tell how you can rejuvenate your old phonograph with the new radio amplification units that give wonderful reproduction from phonograph records

By James Millen........PAGE 218

How to Get Quality Amplification

NUMBER 5: How to build a unit that combines a "B" and "C" power-pack with a two-stage, transformer-coupled, low-frequency amplifier

By Albert G. Craig.......PAGE 221

Radio Hunts for Buried Treasure

By Captain Porter P. Lowry, U.S.A.....PAGE 224

How to Build the Magnaformer 9-8 Receiver

Constructional details for a superheterodyne that gives unusually fine performance with a loop antenna, using eight or nine valves for local or long-distance work

By Laurence M. Cockaday....PAGE 226

Advance Information on the Hi-Q Receiver

Here are some interesting facts about the new principle of high-frequency amplification that gives this receiver great selectivity with sufficient broadness to cover the side-bands

By Raymond F. Yates......PAGE 230

What's New in Radio

Conducted by the Technical Staff..PAGE 233

How to Build a Transmitter for Less Than $30

Constructional details for a short-wave transmitter that employs receiving set valves and batteries

By James Montagnes......PAGE 240

How to Select Audio Amplifiers

The second of a series of articles that tell the experimenter how he should go about choosing low-frequency transformers for various needs

By Professor E. L. Bowles....PAGE 242

The Practical Uses of Negative Resistances

An interesting explanation of the important part that these seldom-understood quantities play in radio

By A. A. Blumenfeld.......PAGE 247

DEPARTMENTS

The Beginner in Radio........*Armstrong Perry*.......... 260
With the Experimenters.......*S. Gordon Taylor*.......... 270
Broadcasts.. 290

VOLUME XII October, 1927 NUMBER 4

Published monthly by Popular Radio, Inc., 119 West 57th St., New York, N. Y.; telephone number, Chickering 1906; Douglas H. Cooke, President and Treasurer; Kendall Banning, Vice-President; Laurence M. Cockaday, Secretary; Emma A. Harm, Asst. Treasurer. Price, 25 cents a copy; subscription, $3.00 a year in the U. S., Canada and all countries within the domestic postal zone; elsewhere, $3.50 a year, payable in advance. The International News Company, Ltd., No. 5 Bream's Bldg., London, E. C. 4, sole distributors in England. Entered as second-class matter April 7, 1922, at the Post Office at New York, N. Y., under the act of March 3, 1879. Additional entry at Jamaica, L. I., N. Y. Copyright 1927, and title registered as a trade-mark by Popular Radio, Inc. Copyright in Great Britain by Popular Radio, Inc., 6 Henrietta St., Covent Garden, W. C., London, England. *For advertising rates, address* Popular Radio, Inc., 119 West 57th St., New York; or 225 North Michigan Ave., Chicago.
Printed in U. S. A.

KENDALL BANNING, *Editor*

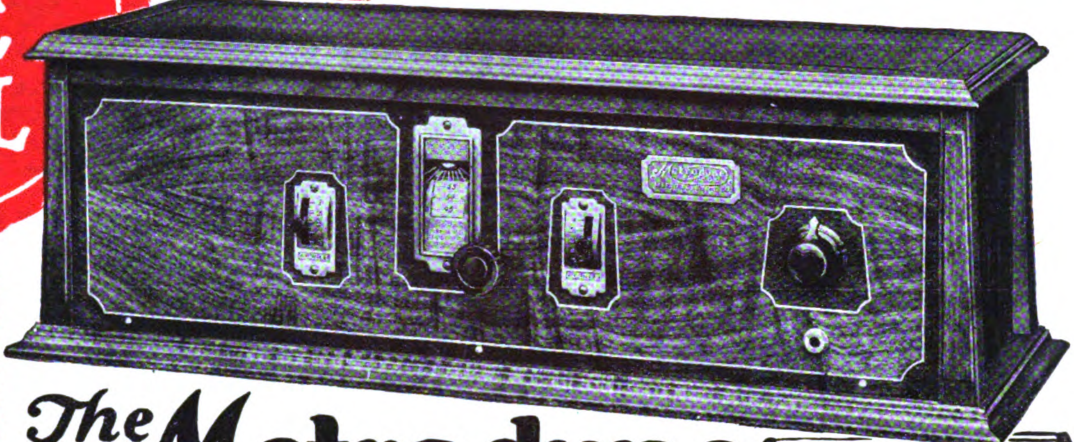
LAURENCE M. COCKADAY, *Technical Editor*

E. E. FREE, Ph.D., *Contributing Editor*

7 Tube Set

Single Dial Radio

30 DAYS FREE TRIAL



Metrodyne Radio Sets
Are Equipped For
BATTERY or ELECTRIC operation

The Metrodyne

ONLY ONE DIAL TO TUNE

RETAIL PRICE
$75.00
Completely Assembled
Big Discounts to Agents and Dealers

Wonderful offer direct from the factory! The world's greatest radio! A perfect working, single dial control, 7 tube receiver! And just to prove our claims, we will ship it to your home for 30 days' free trial. Test it under all conditions. Test it for distance, volume and tonal quality—and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

Three Year Guarantee

BIG PROFITS TO AGENTS AND DEALERS

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon, a letter or a postal for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. **Tested and approved by Popular Science Institute of Standards, Popular Radio Laboratory, Radio News Laboratory** and by **America's leading Radio Engineers.** Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet with beautiful, gilt metal trimmings. Very newest 1928 model, embodying all the latest refinements. Easiest set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, **1,000 to 3,000 miles on loud speaker!** The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.

30 Days' Free Trial—3 Year Guarantee

Metrodyne Super-Six

Another triumph in radio. Here's the new 1928 model Metrodyne 6 tube, two dial, long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. Highest grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station on same dial readings every time — no guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal 30 days' free trial offer, which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis.

6 Tube Set
$48.50
RETAIL PRICE
Completely Assembled

MAIL THIS COUPON
or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer—SAVE MONEY—WRITE NOW!

METRO ELECTRIC COMPANY
2161-71 N. California Ave. • *Dept. 7* • Chicago, Illinois

MAIL COUPON BELOW

Let us send you proof of Metrodyne quality—our 30 days' free trial offer and 3 year guarantee

Mrs. Wm. Leffingwell, Westfield, N. J., writes: "The Metrodyne Radio I bought of you is a wow! This is as good as any $225 machine I have ever seen."

N. M. Greene, Maywood, Ill., writes: "My time is up and the Metrodyne works fine. I got Havana, Cuba, Oakland, Calif., Denver, Colo., Toronto, Canada, all on the loud speaker."

J. W. Woods, Leadville, Colo., writes: "Received the 7-tube Metrodyne in fine condition. Had it up and working same day received. Was soon listening to Los Angeles, San Diego, Oakland and other California points; also St. Louis, Kansas City and other east and south stations—all coming in fine. Am more than pleased. Sure enjoying it."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal 30 days' free trial offer.

METRO ELECTRIC COMPANY
2161-71 N. California Ave., Dept. 7
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer.**

*Name*____________________

*Address*____________________

____

If you are interested in AGENT'S proposition, place an "X" in the square ➡ ☐

A PAGE WITH THE EDITORS

From a photograph made for POPULAR RADIO

THE LC-28 IS EASY TO ASSEMBLE

All the tools required by the home-builder for putting together the set described on pages 214-217 of this issue are a socket wrench and a screw-driver. And the wiring is simpler and easier to install than in any valve receiver yet developed; less than 5 feet of wiring is used—about one-fourth the amount usually required!

SIR OLIVER LODGE'S experiments in broadcasting thought transference (described by him in the September issue of POPULAR RADIO), have apparently attracted wide interest.

* *

FOLLOWING the publication of Sir Oliver's report, other experimenters have sent to the Editors accounts of similar tests made previously. From Mr. E. F. McDonald Jr., of Chicago, comes this report of some experiments in broadcasting telepathy by Dr. Gardner Murphy, of Columbia University, from station WJAZ, New York, on March 2, 1924:

* *

(1): "OVER 2500 reports were received and analyzed."

* *

(2): "WITH the exception of two, all the results were in harmony with the laws of probability; *i.e.*, the successful guesses were about what we would expect from tables of chance coincidence."

* *

(3): "ONE of these two reported throbbing in the left little finger. This was interesting because one of the senders tied a string around his left little finger, but there is no way of computing the chance probability in this case."

* *

(4): "THE report of Miss Florence Wilkes scored three exact successes and two good partial successes. The chance coincidence explanation of her results could not be taken seriously, as the chances were upwards of 100,000,000 against such a score. However, her report was not mailed till March 5th and she had, prior to that date, discussed her experiment with one of the senders. While I have no reason whatever to question her integrity, I cannot take the responsibility of asking scientific men to accept the case as genuine."

* *

HAVE other readers any additional reports on this interesting line of experimentation to submit?

* *

PROF. EDWARD L. BOWLES, who contributes "How to Select Audio Amplifiers" to this issue, is in charge of the Division of Electrical Communication, Department of Electrical Engineering at the Massachusetts Institute of Technology. He lives in Wellesley Farms, Mass., where he spends much of his time in research on low-frequency amplification.

* *

MR. DEREK SHANNON (whose article, "The Effect of Moonlight on Reception," appears on pages 211-213 of this number) ranks as one of the most diligent of the English radio amateurs.

* *

HE HAS been an experimenter for sixteen years. His interest in radio was first caused by a newspaper item; he promptly bought the then available books on the subject, studied the technique and set up a station of his own in Sutton, Coldfield, England. His signals are frequently picked up in Mexico and New Zealand—and it is reported that he can tune in on American stations every evening.

* *

IN this issue POPULAR RADIO gives the complete constructional details of the latest and most efficient of all the long line of products of the Popular Radio Laboratory—the LC-28 receiver.

* *

THIS most advanced of receivers (which is a development of the famous LC-27 that was produced just a year ago) represents over a year of experimentation by the technical staff, headed by Laurence M. Cockaday.

IN quality of tone, in volume, in selectivity, in simplicity of design and arrangement, in ease of construction and operation, POPULAR RADIO believes that this receiver is the best receiver obtainable to-day, regardless of price.

* *

YET the cost of the apparatus required for assembling this set is about $90.00!

* *

THE preliminary announcement of the LC-28, including a consideration of the scientific principles involved in its design, was given in last month's issue of this magazine. In the coming issue—for November—will appear a third article that will tell how to build a low-frequency amplification unit that handles its output properly.

* *

IN the coming issue, also, will be published three other articles of special interest and value to the home-builder and experimenter; one will tell how to build the new Hi-Q receiver (see pages 230-232 of this number); the second will give information on the proper operation of the new Magnaformer 9-8 receiver (see pages 226-229 of this number), and the third will announce the new Octa-monic receiver.

—THE EDITORS

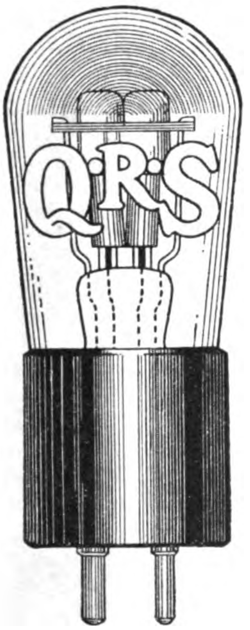
Your "B" Battery Eliminator will give you better service with

Q·R·S

(Trade Mark Registered)

Gaseous Rectifier Tubes

ARE BETTER



60 Milliamperes	-	$4.50
85 Milliamperes	-	4.50
400 Milliamperes	-	7.00

Ask for Catalog of full line of Standard Tubes.

Guaranteed

The standing of the Q·R·S Company, manufacturers of quality merchandise for over a quarter of a century, establishes your safety.

Orders placed by the leading Eliminator Manufacturers for this season's delivery, approximating Four Million Dollars' worth of Q·R·S Rectifier Tubes, establishes the approval of Radio Engineers. Ask any good dealer.

THE Q·R·S MUSIC COMPANY

Manufacturers

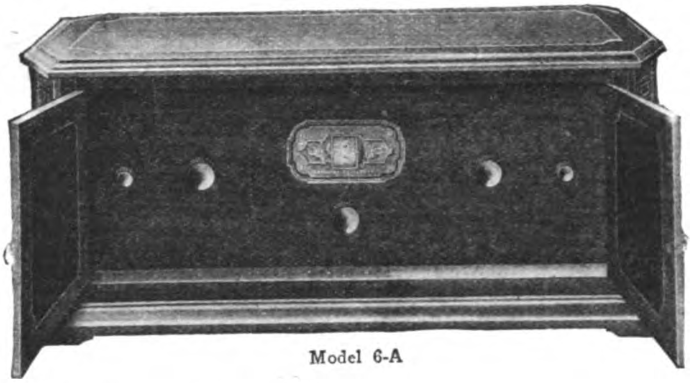
Executive Offices: 306 S. Wabash Ave., Chicago

Factories: Chicago—New York—San Francisco—Toronto, Canada—Sydney, Australia—Utrecht, Holland

Established 1900. References—Dun, Bradstreet, or any bank anywhere

Trade Mark

The Advice of Men Who KNOW Radio "Get a BROWNING-DRAKE!"



Model 6-A

WHEN radio amateurs, . . . men who KNOW radio, are asked by their friends and neighbors to recommend a dependable radio set, they almost invariably reply, "Get a BROWNING-DRAKE!" Why? Because these amateurs have tested every Browning-Drake development themselves and found it to be scientifically sound. They know therefore, that their reputations as engineers and amateur scientists are safe when they recommend Browning-Drake. This unusual recommendation has put Browning-Drakes into over two hundred thousand homes.

Recently the laboratories of the Browning-Drake Corporation presented an entirely new conception of the world-famous Browning-Drake Receiver. Tone, volume, selectivity and distance ability have never before been combined in a single receiver in the same fine way they are brought together in the new Browning-Drakes. These receivers are unconditionally guaranteed and will, we believe, more fully uphold the reputation of the man who KNOWS radio when he advises, "Get a BROWNING-DRAKE!" Ask your dealer to show you the new Browning-Drakes TODAY.

Specifications:

Browning-Drake, Model 6-A (illustrated above), uses conventional Browning-Drake circuit with slight modifications. Four audio tubes give natural tone and great volume when desired. Small auxiliary condenser is provided to bring signals of distant stations to maximum intensity. Beautiful two-tone Duco walnut cabinet harmonizes with all home furnishings. Length, 27 inches; depth, 15 inches; height, 11 inches. List without tubes and batteries, $105.

BROWNING-DRAKE CORPORATION
CAMBRIDGE :: MASS.

DEALERS: Browning-Drake now offers a complete line of receivers and kit parts. Almost three times as many Browning-Drake parts are sold as those of the nearest competitor. Write or wire for further information TODAY.

Model 5-R

Five tubes. Uses three stages of resistance-coupled amplification. Provision for power tube in last audio stage. Cabinet is two-tone Duco mahogany finish. List without tubes and batteries, $95.

Model 7-A

Seven tubes, single dial, illuminated drum control. Completely shielded. Cabinet can be had in either two-tone Duco mahogany or walnut. Length, 30 inches; depth, 15 inches; height, 11 inches. List without tubes and batteries, $145.

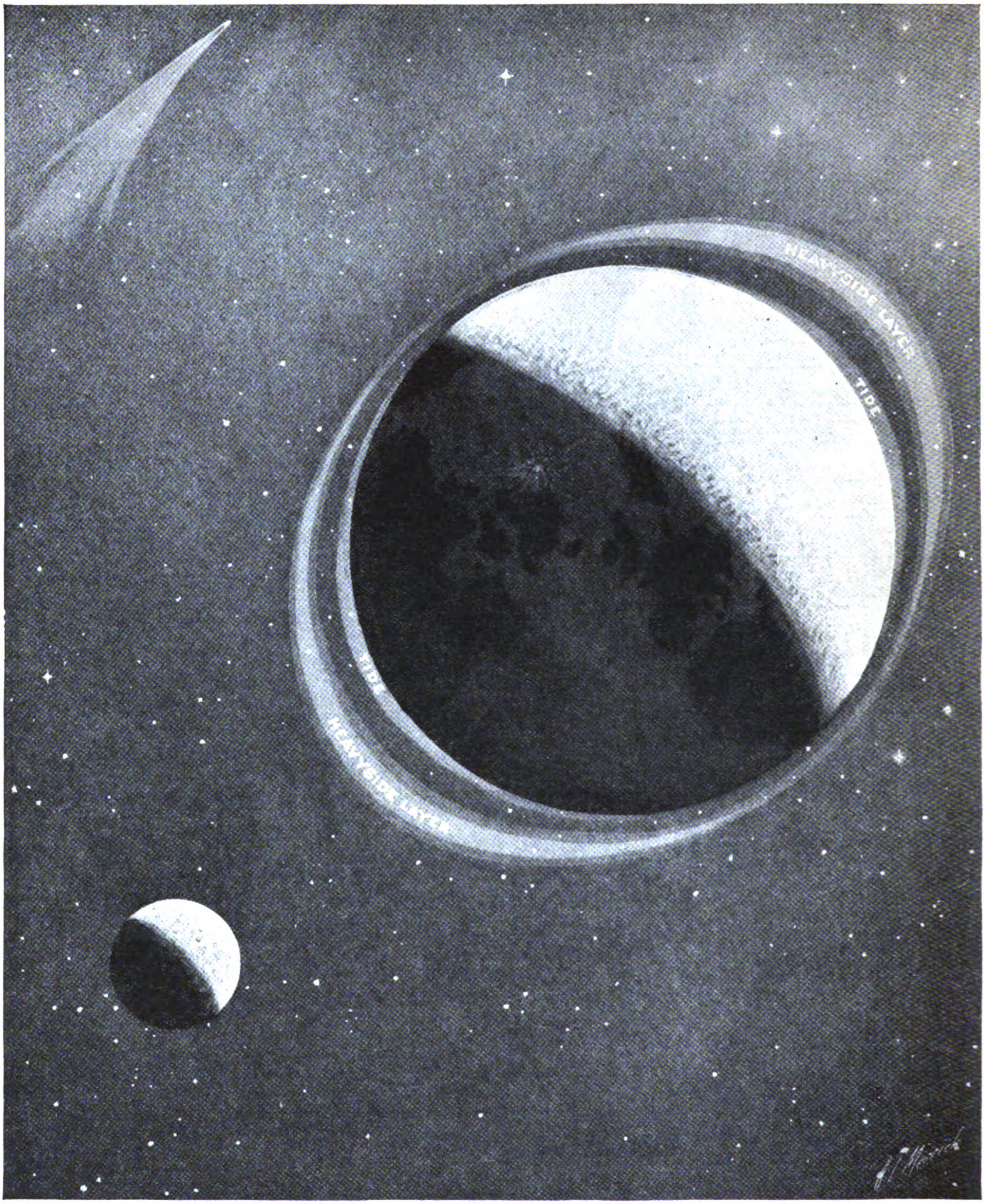
BROWNING DRAKE

CABINETS
PARTS

RECEIVERS
KITS

The RADIO ALMANAC

D.M.	D.W.		**Notable Events and Anniversaries** — October, 1927 — ● **Full Moon, 10th Day 4h. 15m., evening, E**
1	Sa.		1924: POPULAR RADIO introduced the popular four-circuit tuner with resistance-coupled amplifier, developed under the direction of LAURENCE M. COCKADAY.
2	S		1924: Successful experiments were made in the broadcasting of programs from airplanes in flight. *Slightly colder.*
3	M.	☽	1895: SMITH established communication by conduction with the lighthouse on the Fastnet. *Big features in broadcast programs begin this month.*
4	Tu.		1858: DR. MICHAEL PUPIN, who has done invaluable research work in the realms of radio and who holds many radio patents, was born.
5	W.		1922: Transatlantic test messages were successfully sent for the first time with the 20-kilowatt vacuum valves developed by W. G. HOUSEKEEPER.
6	Th.		1866: DR. REGINALD A. FESSENDEN, one of the most prolific of inventors of radio apparatus and the father of the duplex system of radio telephony and of the heterodyne method of reception, was born.
7	Fr.		1914: MAJOR EDWIN H. ARMSTRONG (who later discovered the super-regenerative circuit) obtained his patent rights on his famous feed-back or regenerative radio circuit.
8	Sa.		1918: Progress in the use of continuous wave transmission was very marked, due to the development of vacuum valves and other improvements.
9	S		1920: The removal of war-time restrictions resulted in a great stimulation of interest in amateur radio. *Check over your "A" and "B" batteries.*
10	M.	○	1842: MORSE made wireless experiments by electric conduction through water. *A phonograph pick-up adds another field to your radio reception.*
11	Tu.		1913: The steamship *Volturno* took fire in mid-Atlantic, and in response to a radio message ten vessels rushed to the scene and rescued 521 souls. *Cool and clear—good reception.*
12	W.		1927: The LC-28 receiver, developed by the Popular Radio Laboratory, was introduced to the radio public during this month.
13	Th.		1924: To aid in eliminating interference, the transmitters of several high-powered broadcasting stations were moved to the outlying districts of several cities in the U. S.
14	Fr.		1896: MARCONI'S investigations first led him to the conclusion that "Hertzian waves" could be used for telegraphing without the aid of wires.
15	Sa.		1901: The first fan aerials were erected for experiments in radio transmission and reception between Poldin, England, and Newfoundland.
16	S		1907: Transatlantic radio stations at Clifden and Glace Bay were opened for limited radio public service. *Conditions for DX reception are getting better every day.*
17	M.	☾	1919: The Radio Corporation of America was organized under the laws of Delaware "for the purpose of conducting a general wireless business in the fields of communication, dealing and manufacturing."
18	Tu.		1926: POPULAR RADIO announced the famous LC-27 (the forerunner of the LC-28) radio receiver, developed in the Popular Radio Laboratory under the direction of LAURENCE M. COCKADAY.
19	W.		1862: HEYWORTH patented a method of conveying electric signals without the intervention of any continuous artificial conductor.
20	Th.		1892: STEVENSON advocated the use of an inductive system for communication between the mainland and isolated lighthouses.
21	Fr.		1831: FARADAY discovered electromagnetic induction between two entirely separate circuits. *Take a portable radio on your autumn auto trip.*
22	Sa.		1914: High-powered transoceanic stations were put into operation at Carnarvon, Wales, Belmar, Honolulu and San Francisco.
23	S		1873: DR. WILLIAM D. COOLIDGE, physical chemist, holder of the Rumford Medal and the discoverer of the "death ray" that bears his name, was born.
24	M.		1924: Radio signals from a radio station in East Pittsburgh, Pa., were successfully repeated from a station in Cape Town, Africa. *Why not try the new AC valves on your receiver?*
25	Tu.	●	1844: PROF. EDOUARD BRANLEY, the eminent French radio expert who invented the coherer that bears his name, was born.
26	W.		1915: Successful radio-telephone experiments were carried out between the Eiffel Tower in Paris and the Arlington radio station in Virginia.
27	Th.		1923: Successful tests were made at the Etampes Aerodrome in France with radio-controlled airplanes, flying without pilots.
28	Fr.		1864: CLERK-MAXWELL read to the Royal Society his paper "A Dynamical Theory of the Electromagnetic Field," which laid the foundation for modern theories of the wave propagation of electricity.
29	Sa.		1923: The Vienna Fire department installed receiving sets on its fire apparatus to keep its forces in communication with headquarters. *Tune in on big football broadcasts to-day.*
30	S		1867: DR. LOUIS W. AUSTIN, physicist, since 1923 the chief of the Laboratory for Special Radio Transmission of the Bureau of Standards in Washington, D. C., was born.
31	M.		1926: The use of quartz crystals for maintaining constant frequency on radio transmitters made considerable progress during this time. *Cooler.*



From a drawing made for POPULAR RADIO by Arthur Merrick

Do Aerial Tides Make Reception Better Under a Full Moon?

The gravitational force of the moon creates tides in the atmospheric blanket of the earth similar to those which it produces in the ocean, according to a theory which the experiments of Mr. Derek Shannon seem to substantiate. If this tidal effect is real, the bulges thus created in the Heaviside layer that acts as a reflector of radio waves would affect radio transmission, and particularly long-distance transmission, to a noticeable extent.

Popular Radio

VOLUME XII October, 1927 NUMBER 4

The Effect of Moonlight on Reception

AT one time or another in the past history of mankind the moon has been blamed for nearly everything. The very word "lunacy" means nothing but "moon-struck." Radio has not escaped its theories of lunar influence. Mr. Shannon, a well-known British amateur, provides, however, something more than theories; he has made careful experiments. He finds that the moon *does* influence radio—at least in so far as long-distance reception of short waves is concerned. A full moon means good reception; a dark moon means poor reception. His observations are sure to attract the attention which they so well deserve. With Mr. Shannon's brief theoretical suggestion of a direct effect of the moon in bending the paths of the ether waves we cannot agree. The bendings due to the action of gravity, in accordance with the theory of relativity, are far too small.

There is a more plausible possibility. Both the moon and the sun raise tides in the sea. They also create tides in the atmosphere, although minute ones. There is reason to believe that they produce tides in the upper atmospheric region so important in radio transmission—in the region of the Heaviside Layer. Probably it is some fluctuation of these aerial tides, varying with the relative positions of the sun and the moon and perhaps creating bulges or hollows in the ionized Heaviside region, which must be held responsible for the interesting variations of reception which Mr. Shannon observes. We share his hope that other observers will repeat and extend his work, as undoubtedly they will.

—THE EDITOR.

By DEREK SHANNON, F.R.S.A.

ONE of the outstanding radio problems still to be solved is that of the mysterious variations of signal strength often observed in long-distance reception, even when the power input to the transmitter and all other conditions at both receiving and transmitting ends remain unaltered.

Some station may be received satisfactorily for a considerable time, perhaps for some weeks. Suddenly, for some unknown reason, the signals from that station will become inaudible, or nearly so, on the same receiver. This condition may last for some days, when, for no apparent reason, the signal will again become normal.

Meanwhile nothing has been altered in either transmitter or receiver. This effect has nothing to do, of course, with the well-known phenomena of increased signal strength at night, believed to be due to the layer of ionized gas in the upper atmosphere, known as the Heaviside Layer.

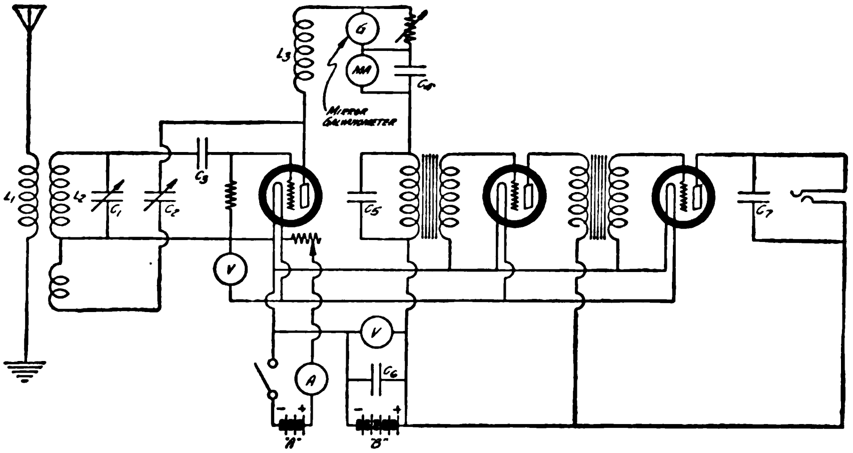
My purpose here is to suggest an entirely new theory to account for these variations in signal strength from time to time, about which so little appears to be known.

I have carried out much experimental work to reach this theory, and I have arrived at some definite results. Other workers in the field may follow up these, I hope, for the benefit of radio science.

When listening to radio transmissions from distant stations I noticed from time to time that on highly moonlit nights the results always appeared much better than at other times. This was true especially for transmissions from the distant stations. This led me to wonder whether the moonlight might have something to do with the effect. I began to make notes of good nights and of bad nights for reception. After a time I found that good reception almost always occurred during the period of full moon, even when the moon itself was obscured by clouds or by bad weather. The moon affects the matter somehow, but I have come to the conclusion that it is not the moonlight which increases the signal strength, but the rotation of the moon round the earth.

I made detailed observations on my reception of the short-wave transmission of KDKA at East Pittsburgh, Pennsylvania, as this station has a fairly constant transmission and is at a distance—3,500 miles—sufficient to make changes in signal strength apparent. My observations were as follows:

As the moon commences to decline from full, the received signal strength of this station also declines. As the moon declines still further the signal strength continues to diminish. At the time when the moon is between the



THE CIRCUIT USED IN MAKING THE TESTS

FIGURE 1: *Here is a schematic diagram of the sensitive regenerative circuit used by Mr. Shannon in England for receiving the signals from station KDKA, in East Pittsburgh, Pennsylvania. Notice that the galvanometer for measuring signal strength is coupled directly to the detector circuit.*

earth and the sun, so that it is dark, the signal strength is at its lowest point. As the moon then begins to increase towards its first quarter, the signals of KDKA show an increase in strength. At first this is very slight; afterward it rapidly increases, and about three days before the moon is full the maximum of signal strength is reached. This maximum remains until about three days past the full, when the signals begin to fade again, and the cycle is repeated throughout the next lunar month.

There were many factors to be considered in the choice of a constant and stable receiver for these tests, especially so because of the short wavelength of 63 meters on which KDKA transmits. After much consideration and many tests I decided to use a simple one-tube circuit with two stages of low-frequency amplification. The chief trouble anticipated was in the use of regeneration, which had to be employed in order to receive KDKA regularly. Being more or less variable, this was the greatest problem.

This difficulty was overcome by using the Reinartz circuit and fitting the regeneration control with a fine vernier adjustment for accurate setting. Once this was set at a critical point, it was never touched again during the test period. Thus handled, the receiver remained quite constant in action. The set was fitted, also, with a filament voltmeter and ammeter and with a plate voltmeter and milliammeter, to insure having exactly the same conditions in the receiver each time that it was used.

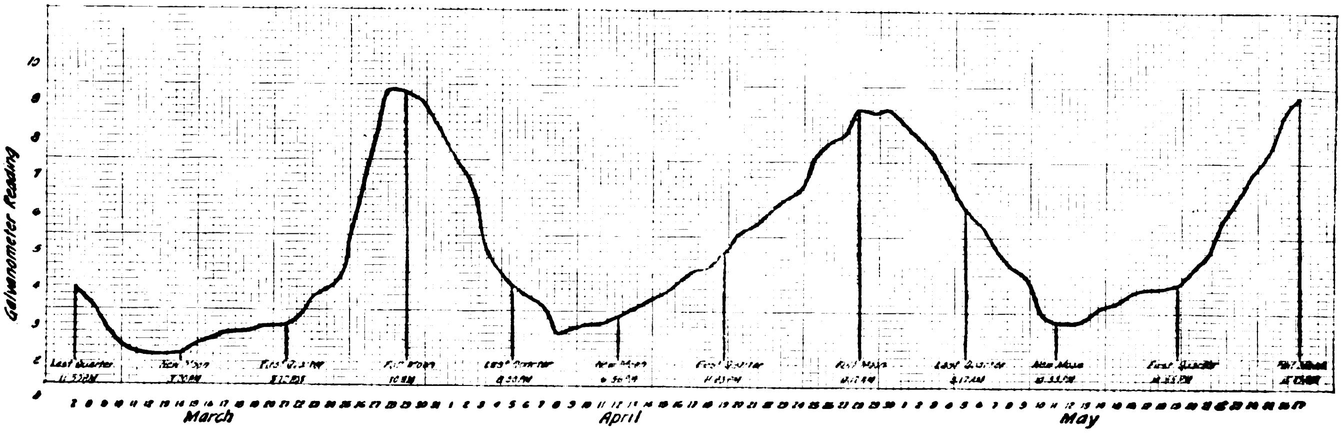
The aerial was of the single-wire, "L" type, fifty feet long, with a twenty-foot down lead. It was forty feet high at both ends, was stretched as tightly as possible between the masts and was kept strained by means of a weight on one halliard. No capacity change could take place by means of the aerial swinging or moving in some other way. It was coupled aperiodically to the receiver.

The ground was only ten feet long, of single fourteen-gauge copper, taken straight to a main water pipe below the set. Every part of the apparatus was fixed rigidly to the test bench. No loose leads were allowed to hang about. The whole of the wiring was done with four feet of square, tinned copper wire. V-24 tubes were used both for the detector and for the low-frequency stages. The low-frequency amplifier was used, of course, for listening to the transmission on telephones. For the actual measurements of the signal strength a sensitive mirror galvanometer was employed.

The deflection of this instrument was not very great, but was magnified by focusing its light spot on a special screen. I so arranged matters that a full-scale deflection of the light spot travelled over a scale of ten inches. The screen was of ground glass, with a scale marked thereon in ten divisions, each division being again split into ten.

In operation, the galvonometer was inserted in series with the plate of the detector tube and was shunted by a variable resistance, to enable adjustments to be made. The light spot was then adjusted to zero on the ground-glass scale, with no signals coming in, but with the receiver switched on and turned to 63 meters. The scale was so arranged that when the carrier wave of the station came in it showed as an increased reading, commencing at zero and finishing at ten. The circuit arrangements are shown in Figure 1.

When all was prepared, preliminary trials were made every night for a week, to determine whether the apparatus would remain stable without adjustments. This was found to be the case, provided all values of voltage and amperage on filaments and plates were



HOW RECEPTION VARIED WITH THE PHASE OF THE MOON

FIGURE 2: *This chart, covering three months, shows how the signal strength, as measured by a sensitive galvanometer, increased and decreased with the waxing and waning of the moon.*

From a photograph made for POPULAR RADIO

LISTENING IN FOR SIGNALS FROM ACROSS THE WORLD

Here is Mr. Derek Shannon, author of this article, with the apparatus that he used in determining the effect of the moon's phases on radio reception. Notice the complete shielding of the receiving set; this and other measures were adopted to prevent any outside influence from affecting the received signal strength.

kept adjusted to exactly the same values used when the apparatus was first set.

A start of the actual readings was made on January 10, 1925 at 11.30 P. M., this being the night of full moon. Observations were taken until 12 o'clock. Slight variations took place during the half-hour, but a reading was taken every five minutes and an average was struck; this average was entered on the curve. This test was then repeated every night until February 8, that being the night of the next full moon. A second test was made commencing on February 23, 1925, the night of a new moon; this test continued every night until March 24, 1925, the night of the next new moon. Since KDKA did not transmit on the short wavelength on Sundays, no readings were made on those days.

The curves for each test show a rise in the signal strength as the full moon approaches. This falls off again as the moon declines. The curves do not show straight lines up and down, but we must take into consideration the fact that slight alterations may take place in the transmitter, which would account for this. This does not alter the clear conclusion that the signal strength rises as the moon waxes and falls as it waves, as the chart in Figure 2 shows.

At present I am attempting to devise a receiver with a number of stages of high-frequency amplification and a carborundum rectifier, in which no regeneration will be used. This will be used on a higher wavelength, and I would suggest to anyone who wishes to carry out experiments along this line that some receiver of this type be perfected. The elimination of regeneration would remove the greatest variable factor—something which is most desirable. It is necessary to lay great stress on the additional necessity of making everything as rigid as possible. The whole apparatus must be untouched during the period of the test. I must add, also, that the galvanometer readings indicate the strength of the carrier wave, not the amount of modulation. This is very important, as the modulation of a telephone transmitter, especially at a broadcasting station, is being altered continually and would provide no indication of the strength of reception.

Many nights, when listening to KDKA during these tests, the speech transmission was nearly inaudible, but the carrier wave was extremely strong. Anyone making these tests should take no notice of the loudness of the speech or music received, but should deal only with the strength of the carrier wave, as shown on the galvanometer.

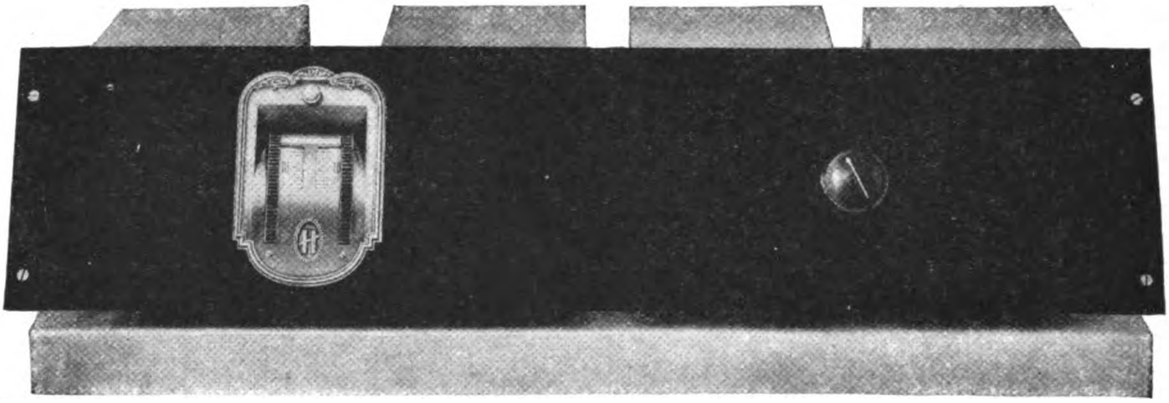
This mirror galvanometer must be of a sensitive type, and the variable resistance placed in a shunt around it must be of sufficiently low resistance to pass the plate current. When adjusting this resistance to obtain the zero reading, great care must be taken that the galvanometer is not burnt out. It is advisable to set this resistance at its lowest value, so that the galvanometer is practically short-circuited, when first switching on the set. The station is then tuned in and all meter readings are carefully noted. Then wait until the station has closed down and adjust the galvanometer to zero by means of the shunt resistance. When the next transmission takes place, the galvanometer will read the strength of the carrier wave. When taking the readings of the galvanometer, it is advisable to stand as far away from the apparatus as possible, in case the set is affected by body capacity.

I have spent so many months making these observations and have checked so carefully the results of the nightly tests that there seems to me no possible doubt that the effect is real and is produced by the moon. About the cause, it is not possible to be so certain. Perhaps the variations of signal strength are caused by the gravitational effect of the moon and the sun, acting on the ether waves and deflecting them from their course in the same manner that light rays are deflected by gravitation. In Einstein's theory of relativity, every kind of matter distorts the ether around itself. Could we not assume that two bodies as near together as the earth and moon, and as constantly changing their positions in relation to each other, might cause a considerable and complicated ether distortion? But this is purely a hypothesis.

There exists one small factor which should not be overlooked. It is that on very bright moonlight nights the atmosphere is usually much more free from moisture than at other times. This may have some bearing on the alteration of signal, although I think not, for it is noticeable that the signal strength usually remains good whenever the moon is full, even on damp nights.

At the present I am engaged on a new series of observations, using more delicate instruments for measuring and recording the variations of signal strength and taking much greater precautions to exclude any possible factor which might give false results. I hope to place on record later on the results of these further tests.

¶Both for the man who has never built a set before and for the experienced set builder the LC-28 offers a unique opportunity of easy construction with unexcelled results.



THE TWO-FISTED CONTROL PANEL OF THE LC-28

Figure 1: *This view gives some idea of the absolute simplicity of the LC-28. At the left is the double drum dial for tuning, and at the right is the combination battery switch and volume control.*

HOW TO BUILD THE NEW

LC-28 RECEIVER

Popular Radio *believes that outstanding qualities of the LC-28—sensitivity suitable for distance reception without an antenna, tone quality adaptable to any taste, and selectivity sufficient to eliminate interference without causing distortion—make it a receiver unrivaled in the field of radio construction.*

By LAURENCE M. COCKADAY

Cost of Parts—*Not over $91.00*

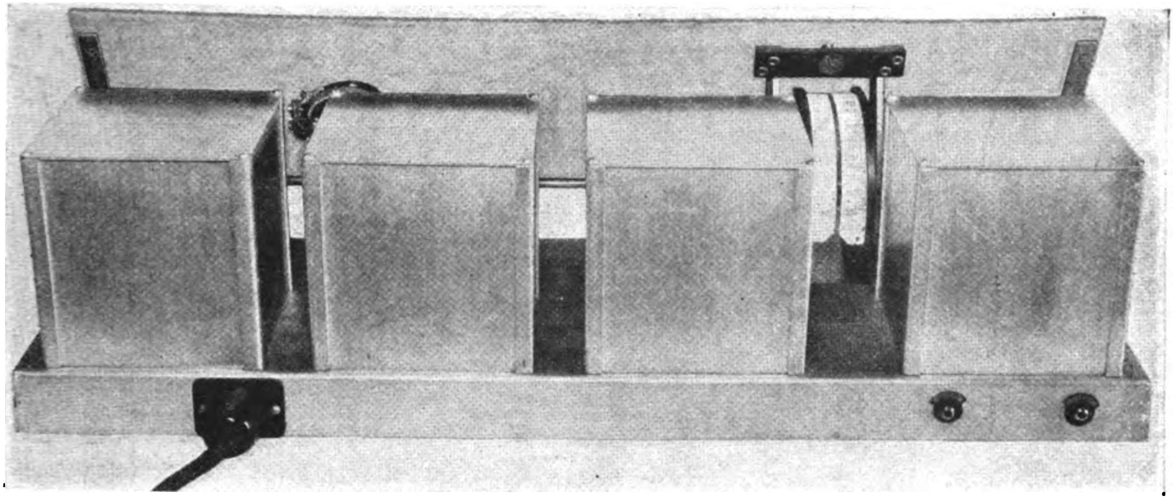
Here Is a List of Instruments and Accessories Necessary for Building This Receiver—

A, B, C and D—Precision radio-frequency transformers (4 transformers), type 4-B;
E1, E2 and E3—Samson high-frequency chokes, type No. 125;
F—Samson high-frequency choke, type No. 85;
G—Lynch suppressor, 500 ohms;
H—Lynch suppressor, 600 ohms;
I—Lynch suppressor, 700 ohms;
J1, J2, J3 and J4—Hammarlund mid-line variable condensers, .000275 mfd.;
K1, K2 and K3—Aerovox moulded condensers, .02 mfd.;
L—Aerovox moulded condenser, .00025 mfd.;
M—Aerovox moulded condenser, .00075 mfd.;
N—Durham metallized resistor, 6 megohms;
O1, O2, O3 and O4—Carter fixed resistors, type H-4, 4 ohms;
P1, P2, P3 and P4—Benjamin vibrationless sockets;
Q—Yaxley cable connector plug with cable, type 660;
R1, R2, R3 and R4—Special small size aluminum box shields for LC-28, made by the Aluminum Company of America;
S—Yaxley combination switch and rheostat, type No. 906-K, 6 ohms;
T1 and T2—Carter "Imp" plugs and tip jacks, marked "Antenna" and "Ground," respectively, with insulating washers for the antenna;
U—Hammarlund double-drum dial;
V—Brass extension shaft, 16½ inches long and ¼ inch in diameter;
W—Aluminum panel, 6 inches by 26 inches, drilled and decorated, made by Wholesale Radio Service Company;
X1 and X2—Tait brackets;
Y—Aluminum chassis for the LC-28, made by the Aluminum Company of America;
Z—Lynch single-resistance mounting;
Wire, screws, nuts, etc.

THE unique design, both from a mechanical and an electrical standpoint, of Popular Radio's latest contribution to radio science, the LC-28 receiver, should make it ideal for radio broadcast reception. It embodies, as told in the September number, many new and advanced electrical principles, as well as a mechanical design that is exceptionally well suited to the constructional ability of the home set-builder. Upon final completion, the LC-28 receiver should be comparable, both in construction and in operation, to the finest set now obtainable.

It is the claim of Popular Radio's technical staff that anyone can build the set and obtain the expected results without previous knowledge of set building, and without any electrical or mechanical ability, by simply following exactly the constructional information in this article.

Some of the reasons for advancing



SOLID CONSTRUCTION MAKES THE LC-28 A PERMANENT JOB

FIGURE 2: *The four stage shields containing the amplifying apparatus are mounted on a metal chassis. The metal panel to which are attached the drum dials is also mounted on the chassis by means of sloping metal brackets.*

this claim are set forth below:

First: The set is built entirely on a metal chassis, completely stamped and drilled and ready for mounting the instruments. It contains a complete set of shields and a metal panel drilled and engraved. In assembling, the only instrument necessary is a screw-driver.

Second: The wiring is exceptionally easy to do, as there is only approximately five feet of wire in the complete job.

Third: The instruments are mounted with brass machine screws and nuts that are obtainable in any hardware store.

The receiver has an exceptionally high amplification and yet is easy to tune by a double drum control.

The appearance, when placed in the special consoles made for it, is in keeping with the finest receivers furnished. The set may be used with no antenna at all, with a loop, or with any form of indoor or outdoor antenna.

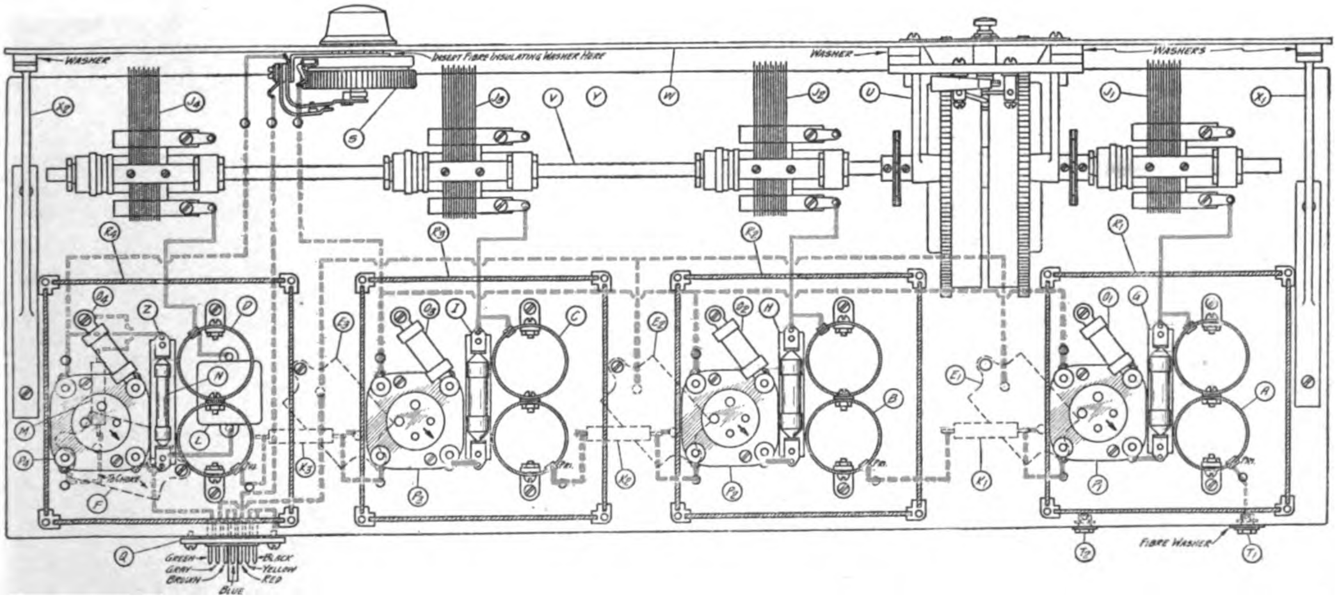
The fundamental circuits employed in the LC-28 high-frequency pack is given in Figure 5.

How to Assemble the Instruments

The making of the new receiver is simplified to such an extent that it is hardly necessary to tell in words how to build it. The accompanying illustrations and diagrams tell the story at a glance; but to be doubly sure a complete outline is here given showing the constructional details in the best possible order of procedure.

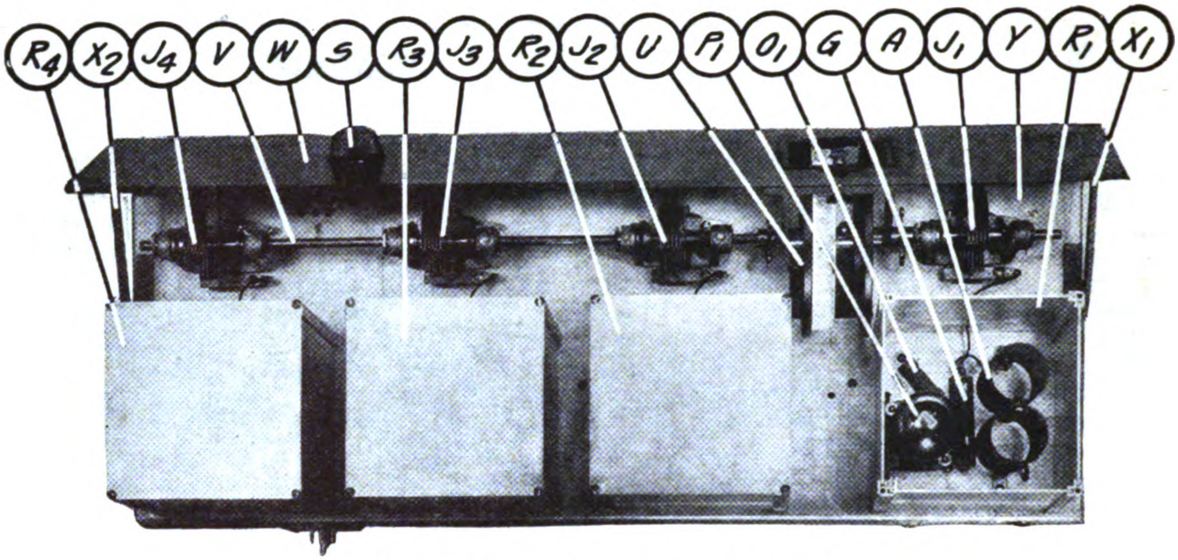
The aluminum chassis, Y, comes from the manufacturer already prepared, drilled, cut, stamped and finished. The same is true of the front panel, W, and the four sets of shields, R1, R2, R3 and R4.

The first job in putting the set together is to mount the various instruments on the chassis, Y. It would be advisable first to mount the four high-frequency choke coils, E1, E2, E3 and



AN ALMOST "WIRELESS" RADIO RECEIVER

FIGURE 3: *The careful planning that has gone into this receiver has eliminated at least 70 per cent of the usual wiring. In this diagram the instruments above the panel, in their correct positions, are outlined in solid* BLACK *lines; those below the panel are shown in dotted* BLACK *lines. The wiring above the panel is shown in solid* RED *lines, and the wiring below the panel in dotted* RED *lines. When the set is completed only one wire is visible in each stage—the wire that connects to the stators of the variable condensors.*



A VIEW OF THE RECEIVER FROM ABOVE

FIGURE 4: *The cover of one of the stage shields has been removed to show the arrangement of the coil, valve, stabilizing resistor and the fixed filament resistor. The four tuning condensers with the drum dials attached may be seen behind the front panel.*

F, underneath the chassis, Y, in the two proper holes drilled for them, as shown in Figures 3 and 6. In mounting all of the instruments, the screw heads of the mounting screws should all be attached from above the chassis, and the nuts should be put on from the under side.

Next, set up the four sockets, P1, P2, P3 and P4, as shown in Figure 3. These should be mounted with two machine bolts and fastened underneath with two corresponding nuts tightened securely.

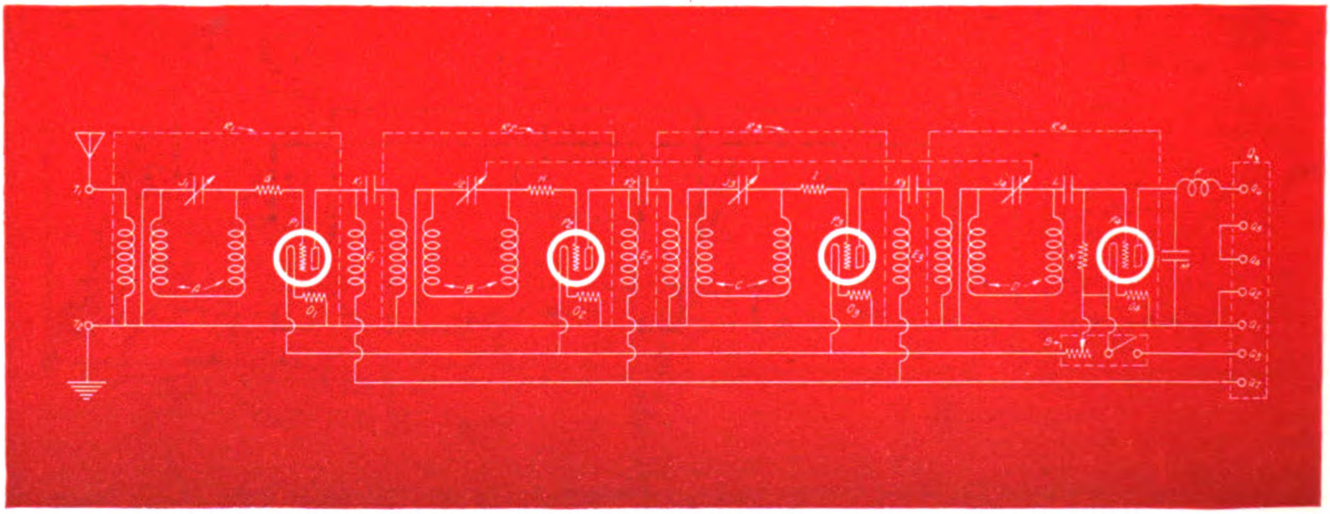
Next, fasten one end of the four resistances, O1, O2, O3 and O4, to the binding posts marked "—" of the four sockets, P1, P2, P3 and P4. This is done by first unscrewing the knurled nut on the binding post, then placing the ringed terminal of the resistance over the bolt and fastening down tightly with the knurled nut. The other end of the four resistances should be fastened with a bolt and nut to the proper holes in the chassis, Y, as shown in Figure 3.

Next, set up the four high-frequency transformers, A, B, C and D, in their proper places, as shown in Figure 3. This operation requires two nuts and bolts to each instrument.

Now set up the three suppressor mountings, G, H and I, and the grid-resistance mountings, Z, in their proper positions on the chassis, Y. This is

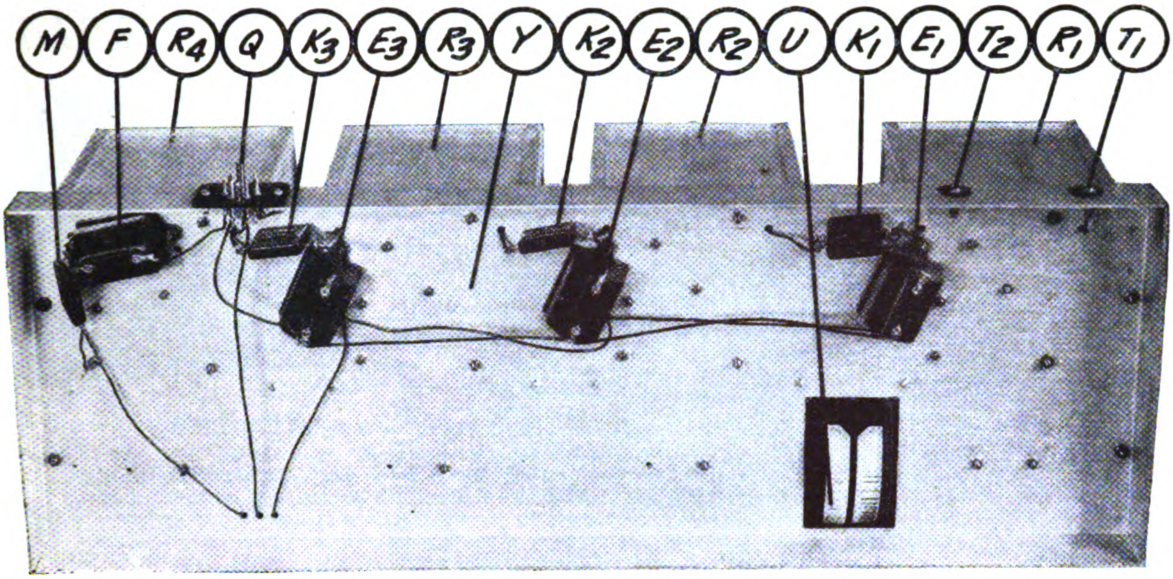
---

¶ *The list of parts given on page 214 includes the exact instruments used in the laboratory model of this receiver. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instrument. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers,* POPULAR RADIO SERVICE BUREAU, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE SCHEMATIC DIAGRAM OF THE LC-28 CIRCUIT

FIGURE 5: *The condenser of the first high-frequency stage, at the left, is tuned by one tuning drum; the condensers of the two following stages and the detector stage, at the right, are tuned together by the other.*



THE UNDER SIDE OF THE LC-28 SUB-PANEL

Figure 6: *The chokes and condensers, with their wiring, are shown in their correct positions. A portion of the double drum may be seen protruding from the cut-out.*

shown in Figure 3. One screw and a nut is used in each case.

Next, fasten down temporarily the four variable condensers, J1, J2, J3 and J4, as shown in Figure 3. These are attached to the chassis, Y, by a single bolt and a nut, except in the case of condenser J4. The reason for mounting these condensers with only one bolt and nut to each is that this will allow them to line up properly when the single extension shaft, V, is attached to all three condensers.

Now attach the plug of the Yaxley cable, Q, in the place made for it, as shown in Figure 3. The metal bracket of the plug is not used and the screws are inserted in the screw holes of the bakelite strip that originally held the bracket.

When this is done, the two tip jacks, T1 and T2, marked "Aerial" and "Ground" should be installed, as shown in Figure 3. The one, T1, marked "Aerial" should be insulated from the chassis with insulating washers, and the one, T2, marked "Ground" should be installed without insulating bushings and should be attached firmly to the metal of the chassis, Y.

This completes the constructional work on the receiver up to the point where the wiring should be done. The remaining constructional work should be left over until the wiring is practically completed.

How to Wire the Set

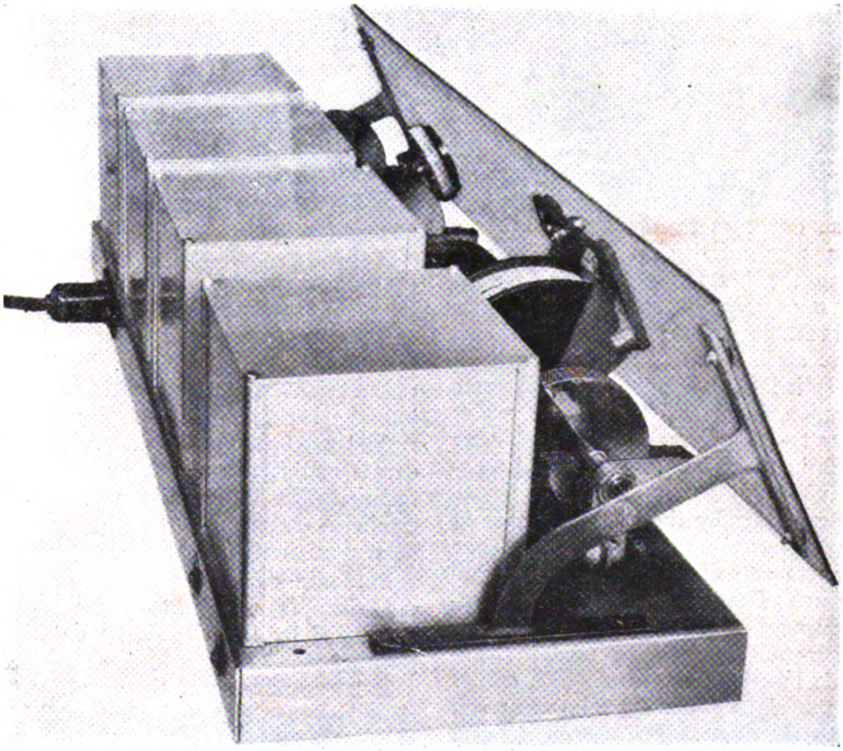
The design of this set is such that the wiring is accomplished, in as many cases as possible, by the mere act of fastening down the instruments onto the metal chassis. This is the case with one connection (the grounded connection) of each of the variable condensers, J1, J2, J3 and J4; with two connections of each of the high-frequency transformers, A, B, C and D, and with one connection of each of the resistances, O1, O2, O3 and O4. It is also the case with all the connections to the ground and the "A" minus (—) and the "B" minus (—) terminals of the power supply.

This feature eliminates probably 15 or 20 feet of wiring that would ordinarily have to be done, and leaves the set completely hooked up with approximately five feet of wiring. *This makes for simplicity!*

All connections should be made with a tinned copper flexible wire, insulated with a hard coating, such as "Celatsite."

Refer to the picture-wiring diagram

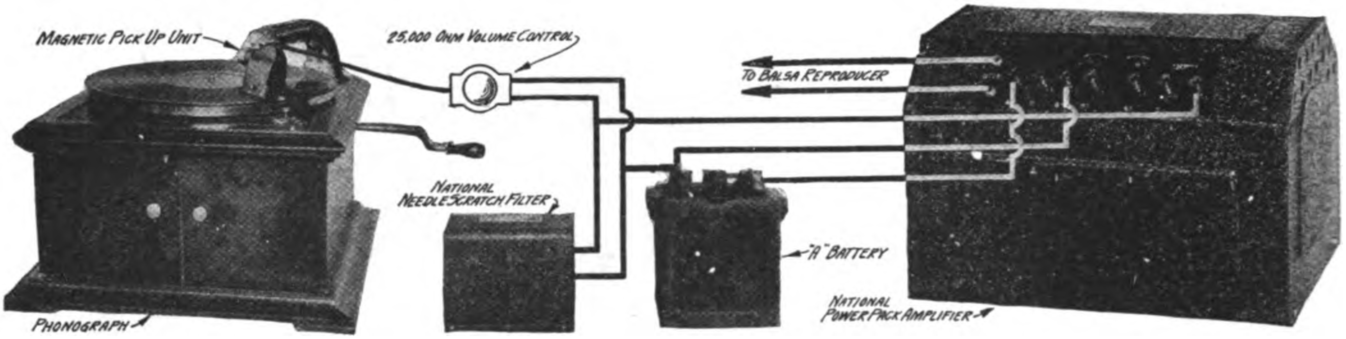
(*Continued on page 286*)



AN END VIEW OF THE RECEIVER

Figure 7: *This view shows the receiver fully wired and assembled, and ready to be installed in its cabinet.*

¶ *The third of the series of articles on the new electrical units that enable you to reproduce phonograph programs with the tone quality and volume of the best radio reception.*


MAGNETIC PICK UP UNIT
25,000 OHM VOLUME CONTROL
TO BALSA REPRODUCER
NATIONAL NEEDLE SCRATCH FILTER
"A" BATTERY
NATIONAL POWER PACK AMPLIFIER
PHONOGRAPH

A MATCHED COMBINATION THAT PUTS NEW REALITY INTO PHONOGRAPH REPRODUCTION

FIGURE 1: *This easily assembled hook-up employs a power-pack amplifier (shown at the right) that operates from the AC lighting lines. This power-pack amplifier may also be used with any high-frequency amplifier for the reception of broadcast programs—thus making possible two forms of program reproduction with the same low-frequency amplifier and loudspeaker.*

HOW TO ADD TO YOUR OLD PHONOGRAPH

The New Amplification Units

This installment in the series of articles on the phonograph pick-up units gives new and valuable information on the correct methods of choosing and matching units to obtain the best results in phonograph reproduction. It also gives details for assembling a matched hook-up that employs one of the new combination power-pack amplifiers; this amplifier is a complete instrument operating from the AC lighting lines, that may be used either with a phonograph pick-up or a high-frequency amplifier.

By JAMES MILLEN

NOT so very long ago there existed in the minds of many people some doubt as to whether or not the then new novelty, radio, could ever reach the "perfection" of the phonograph as regards tone quality, service and reliability. Now, on the other hand, there again seems to be some doubt in the mind of the public on the same question, but from the opposite angle: "Can to-day's phonograph compete with radio in tone quality, service and reliability?"

Benefitting by the advances made in the acoustical art as a result of the developments of radio, the electric phonograph of to-day is similar to the low-frequency amplifier, reproducer and power-pack combination used in high-grade broadcast receivers. The output of the electric phonograph, when one gets right down to the matter, is but a standard broadcast program which, instead of being sent over the air, is recorded in a permanent manner and delivered to the consumer on a platter.

With these improvements, and one other—the elimination of the record scratch—the modern phonograph becomes a highly desirable companion to the modern radio receiver.*

However, the phonograph can never take the place of the radio. First, the radio brings news and entertainment into the home as it is actually occurring—banquets, speeches, sporting events and many others; and, second, radio supplies its own program; its repertoire is not limited by the number of records in the album.

But as a companion to modern radio, there is a distinct service to be performed by the electrically operated phonograph.

It is the purpose of these articles to show how standard equipment available on the radio market may be grouped together to improve and beautify the results of the old-style phonograph by radio methods. Furthermore, another article to appear in a future issue of POPULAR RADIO will give the constructional details for a single-control, two-valve set which is so designed as to employ the same power-pack, low-frequency amplifier and reproducer as the electrical phonograph will use. The complete combination may be housed in a specially built cabinet, a radio cabinet or an old-style phonograph console cabinet.

But first let us consider the various components of the phonograph—the pick-up, the needle scratch filter, the volume control, the amplifier and the reproducer.

Pick-ups and Volume Control

There are at least four different types of pick-ups. The electromagnetic and the crystal types function by generating voltages, while the condenser and the carbon forms operate by variations of impedance.

---

* For previous articles on the Electrical Phonograph see the July-August and September, 1927, issues of POPULAR RADIO.

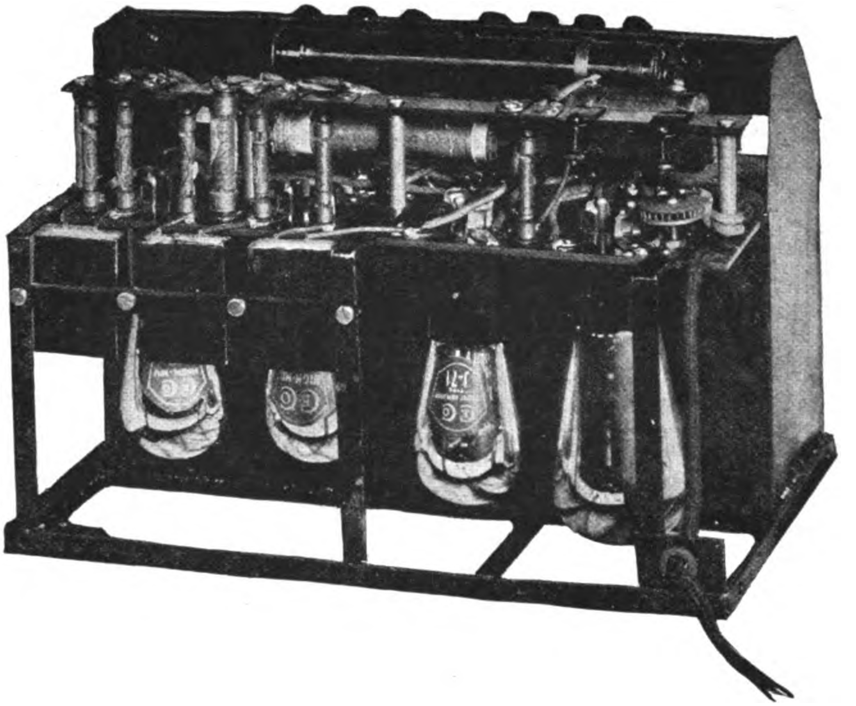
Of these four, the most popular type at present is the electromagnetic form. To this class belong the pick-ups used in the "Electrola," the "Panatrope" and the "Vitaphone." This latter is in reality a special electric phonograph designed for synchronization with a motion picture projector.

One of the large corporations interested in the development of radio is experimenting with a pick-up of the crystal type, but as yet this unique device is still in the experimental stage.

Pick-ups of the carbon type have been in existence for a number of years, but only recently has one capable of high-quality reproduction been perfected. This type of pick-up, which depends for its operation upon the change of its electrical resistance with vibrations of the needle, is in a somewhat different class from the others, as it is designed to operate a reproducer without the use of an amplifier.

Pick-ups can be made of the same parts that are used in the construction of the ordinary radio-type headphones and reproducers. As a rule, however, for best results a unit designed "from the ground up" as a high-grade pick-up should be used. Several units of this type are now being manufactured.

In mounting the pick-up, fasten its base in such a position that the needle, when swung to the center of the record, will rest in the exact center of the turntable shaft. The pick-up selected must be capable of high-quality reproduction or the best results cannot be expected. The Pacent, the Warford and the Bosch "Recreator" have been found extremely satisfactory. Most pick-ups have a volume control located on the base of the stand. If not, a 25,000-ohm resistance, such as a Royalty or the Centralab Radiohm, may either be mounted in the turntable compartment or on the panel of the receiver.



A VIEW OF THE POWER-PACK AMPLIFIER FROM THE REAR

FIGURE 2: *This picture gives an idea of the layout of the complete power-pack amplifier with its metal case removed. The vacuum valves are inserted from the bottom and are protected from dust and mishandling while in use.*

The Needle Scratch Filter

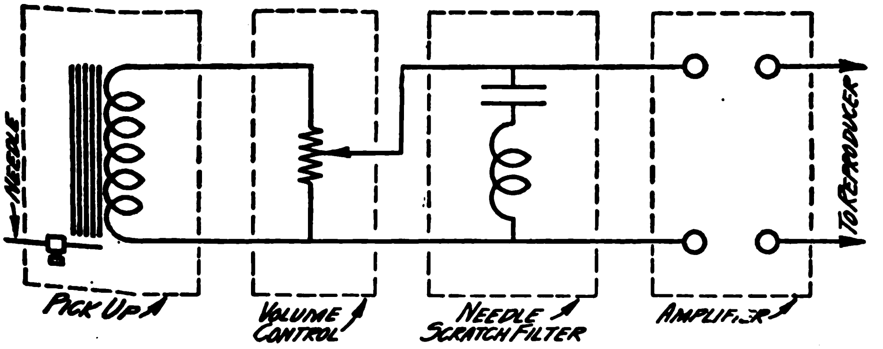
The scratch filter is for the purpose of electrically removing from the output of the reproducer the "hiss" due to the contact of the needle on the record.

While an electrical filter circuit of the type indicated in Figure 3 will remove all objectionable scratch noises from the music issuing from the loudspeaker, it will not prevent one hearing the unamplified scratch noise directly from the record. For this reason the lid of the turntable compartment should be kept closed while records are playing.

While the connection of a .006 mfd. fixed condenser across the output of the pick-up or input to the amplifier will also remove this noise, such an arrangement will also remove many of the higher frequencies and thus partially destroy the quality of reproduction. For this reason an electrical filter circuit, tuned to stop the passage of only those currents in the neighborhood of the scratch frequencies, should be used.

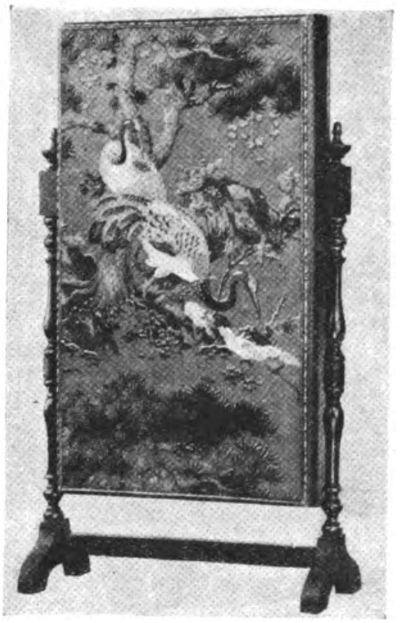
The difficulty in completely eliminating scratch noises lies in the fact that the scratch frequency is not any one frequency, but quite a wide frequency band. If, however, the filter circuit is tuned to approximately 4,500 cycles, the greater part of the scratch noise is removed without the sacrifice of tone quality. The residual hiss, when a scratch filter is employed, is practically unnoticeable and cannot be detected except for the first few seconds or so before the music starts.

Such a device may either be purchased as a complete unit (one is made by the National Company) or may be constructed at home from a choke coil and condenser so selected as to be most effective at about 4,500 cycles. This frequency peak should be somewhat "broadened" by the use of a very small quantity of iron in the construction of the inductance. A scratch filter can be assembled by employing a 1,500-turn honeycomb coil with a .008 mfd. fixed condenser. The circuit for the scratch filter is shown in Figure 3.



THE CIRCUIT EMPLOYED IN THE COMBINATION UNIT

FIGURE 3: *This diagram shows the simplicity of the electrical circuit used in the pick-up and amplifier combination. The reproducer connects directly with the amplifier and may be used in any part of the house by employing an extension cord.*



AN ARTISTIC REPRODUCER

FIGURE 4: *This is one of the decorated Balsa-wood reproducers that may be built in the form of a screen and that gives reproduction of excellent tone quality.*

The Amplifier

The amplifier is probably the most important part of the electrical phonograph system. It should have a straight-line frequency characteristic extending well down into the lower frequencies and have sufficient overall gain and undistorted power output for supplying all the volume required for home use.

Such a device is the National combination power-pack amplifier, shown in Figure 2, which is not only a complete high-quality low-frequency amplifier designed especially for phonograph and radio use, but also has the advantage that it requires no "B" or "C" batteries.

The compact little unit consists of two stages of resistance-coupled voltage amplification and one stage of power amplification with special impedance input and output circuits.

The input impedance in the power stage is for eliminating that difficulty encountered with many resistance-coupled amplifiers—the tendency to "motor-boat." The output impedance is for the protection of the reproducer from possible damage due to the heavy plate current drawn by the power valve.

The power-pack circuit is essentially the same as that employed in the Nation "B" power-pack, including the new adjustable, fixed-output potentiometer. In addition, however, a special winding is provided on the power transformer for heating the filament of the UX-171 type power valve. The amplifier is completely adjusted before leaving the factory, so that it is only necessary for the user to insert the valves and connect it to his pick-up and reproducer, as shown in Figures 1 and 5.

The Reproducer

Good reproducers are of four general types: the large cones, such as the Western Electric; the small baffle cones, such as those devised by Messrs. Rice and Kellogg and used in the "Electrola" and "Panatrope"; the new Balsa-wood flat type, and the orthophonic variety of exponential horns, such as the Newcomb Hawley, the Temple and the Racon.

The Lata Balsa-wood reproducer may be mounted on an easel placed in any convenient part of the room, or hung on the wall in picture fashion. These reproducers, aside from their high electrical excellence, have the additional advantage of distinctive appearance and low cost. It is not at all a difficult problem to construct a very fine speaker in an evening for only $18, the cost of the complete kit. Figure 4 gives an idea of the artistic possibilities of this type of reproducer.

If a cabinet type of orthophonic horn is used, the amplifier and other apparatus may be located right in the cabinet. The turntable, in such a case, may be placed in a small cabinet on top of the speaker. In fact, one of the old table-model phonographs, to which a magnetic pick-up has been added, will be just the thing.

Where a console type of phonograph cabinet is available, the most desirable arrangement is to remove the old horn, and in its place behind the silk grille locate a baffle-type speaker, such as the new Radiola 100-A, or the latest electric-dynamatic movable coil type of Magnavox cone.

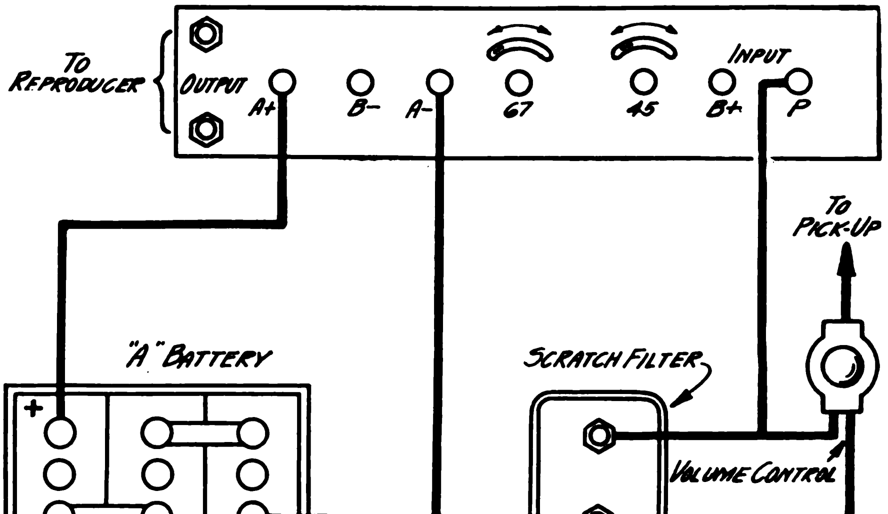
The baffle board for mounting such speakers should be of about one-half inch thick white pine or other soft wood. A round hole should be cut in the center of the board and so beveled that the outside diameter is slightly larger than the inside diameter. The cone framework is then bolted in place so that the cone is centered behind the hole.

Thin veneer should not be used as a baffle board, as it may prove to be resonant at some frequency within the audible range.

Though the preferred arrangement for an AC-operated phonograph is the use of an induction motor to operate the turntable, such motors of the proper size are rather difficult to obtain. Most phonograph dealers, however, stock excellent motors of the universal type, which, as they are only run when the radio receiver is not in operation and will therefore cause no interference, are entirely satisfactory. Such motors cost from $15 to $30.

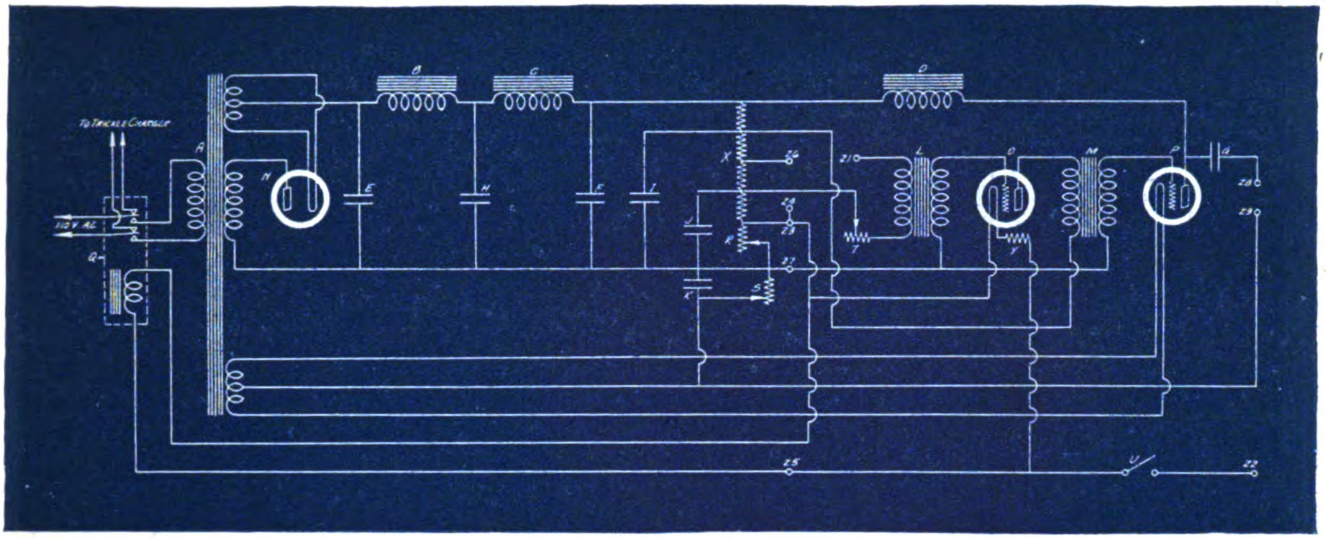
If a spring motor is used in the phonograph the amplifier should be so placed that the rectifier and power valves, which become quite warm in operation, are not directly under the motor, for such placement might cause the graphite in which the spring is packed to melt.

In conclusion, it is well to emphasize the importance of using the new electrically cut records for obtaining the best results with the phonograph.



HOW THE UNITS ARE TO BE CONNECTED

FIGURE 5: *This diagram gives the exact connections for the power-pack amplifier, the scratch filter and the volume control, as well as the connections to the "A" battery for lighting the filaments of the vacuum valves. A metal link comes with the amplifier that connects the "B" negative terminal to the "A" negative terminal, so that this connection is not shown in this diagram.*



THE SCHEMATIC DIAGRAM OF THE POWER-PACK AMPLIFIER

Figure 1: *At the right is the rectifier circuit of the unit, with the connections to the 110-volt AC lighting line and to the automatic relay that controls the trickle charger of the "A" battery. In the center of the diagram is the filter circuit, and at the right is the circuit of the two-stage, transformer-coupled, low-frequency amplifier.*

How to Get Quality Amplification

NUMBER 5: *How to build a unit that combines a "B" and "C" power-pack with a two-stage, transformer-coupled, low-frequency amplifier. This unit may be used to improve the volume and quality of any old receiver by hooking it up to the output of the detector valve, or it may be combined with any type of high-frequency amplification that the experimental set builder desires, to make a new receiver. The unit is entirely self-contained and may be installed in a console with the high-frequency pack or operated separately.*

By ALBERT G. CRAIG

COST OF PARTS: *Not over $117.00*

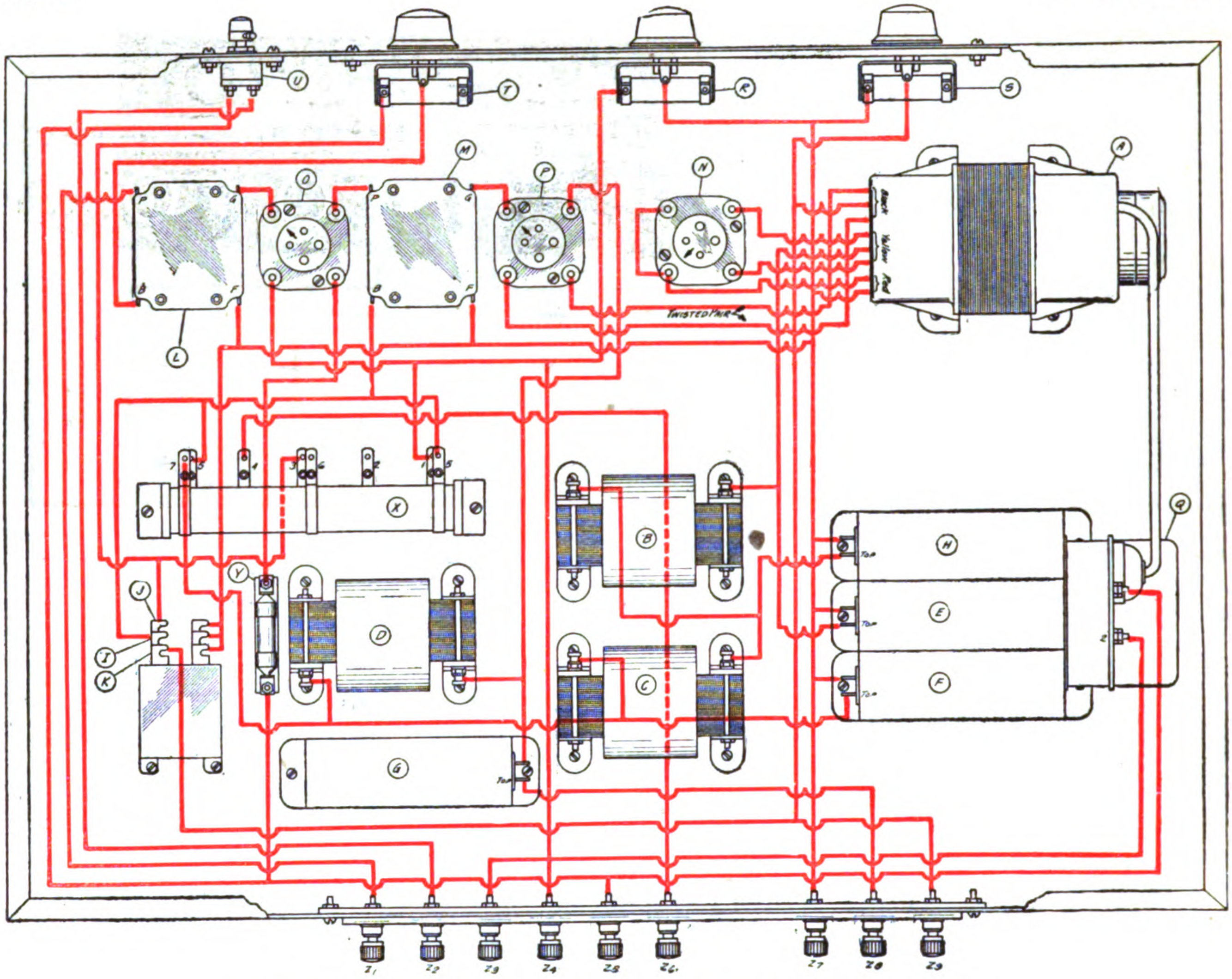
HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES NECESSARY FOR BUILDING THIS UNIT—

A—AmerTran Transformer, PF-52;
B, C and D—AmerChokes, type 854;
E, F and G—Tobe high-voltage condensers for 1,000 volts DC operation, No. 602, 2 mfds.;
H—Tobe high-voltage condenser for 1,000 volts DC operation, No. 604, 4 mfds.;
I, J and K—Tobe filter condensers, type 301, 1 mfd., for 300 volts DC;
L—AmerTran DeLuxe transformer, first stage;
M—AmerTran DeLuxe transformer, second stage;
N, O and P—Benjamin Cle-ra-tone vibrationless sockets;
Q—Yaxley multiple type relay, No. 445;
R and S—Electrad Truvolt variable resistors, 2,000 ohms;
T—Electrad Truvolt variable resistor, 50,000 ohms;
U—Carter "Imp" battery switch;
V—Baseboard, 9 by 19 by ½ inch;
W—Imperial sheet metal box equipped with insulating panels for binding posts, the variable resistors and the battery switch;
X—Combination AmerTran resistor, type 400, for AmerTran power-pack;
Y—No. 1-a amperite;
Z1, Z2, Z3, Z4, Z5, Z6, Z7, Z8 and Z9—Eby binding posts;
25 feet of flexible rubber-covered wire;
Mounting screws, nuts, etc.

THE experienced radio fan and professional set builder, who is looking for quality reproduction, will find in this combination amplifier and "B" power-pack a unit that will give him the best type of program rendition with superb volume and tone quality that is hard to equal.

The complete unit may be built as shown in the illustrations in a ready prepared metal box or can that houses all of the instruments and "live" parts. The metal case, once the unit has been assembled, may be slipped into the console of a radio receiver and connected up in a few minutes. It will furnish "B" and "C" power for the high-frequency end of the receiver with which it is used and needs no further attention when once installed and set into operation.

The amplifier employs two stages of high-quality, transformer-coupled amplification, using a UX-201-a type valve



THE PICTURE-WIRING DIAGRAM OF THE POWER-PACK AMPLIFIER

FIGURE 2: *In this diagram all of the apparatus that is mounted on the baseboard, inside of the metal case, is shown in* BLACK *lines, as well as the parts and equipment that are mounted on the case itself. All of the wiring is shown in heavy* RED *lines running to the correct terminals of all of the instruments.*

in the first stage and a UX-210 type power valve in the second stage. A standard UX-216-b type rectifier valve is used in the power-pack to rectify the high-voltage alternating current.

The smoothing filter is a two-stage choke and condenser type filter. An output filter consisting of a choke and condenser is also attached to the amplifier for protecting the reproducer from current overloads. Leading engineers claim that this is the most efficient type of amplifier for use in modern radio reception, and its use, when correctly laid out, designed and built, is recommended to all radio fans who wish either to improve an old set as to its tone quality and volume, or who wish to incorporate the unit in a new receiver.

The schematic wiring diagram of the new power-pack amplifier is shown in Figure 1.

How to Construct the Amplifier

The wooden baseboard should first be cut to a size 9 inches by 19 inches by ½ inch and reinforced with two cleats across the bottom.

The instruments should now be mounted in the positions shown in the picture-wiring diagram, Figure 2, and the top view of the amplifier, Figure 4. Note particularly the location of the terminals of each instrument. First mount the three sockets, N, O and P, and the two low-frequency transformers, L and M, on the baseboard, V. Secure the power transformer, A, the three large condensers, E, F and H, and the three AmerChokes, B, C and D, to the base, V. Complete the base mounting by fastening the amperite, Y, the large condenser, G, the three small condensers, I, J and K, and the resistor, X, to the base, V. It should be noted that the three small condensers, I, J and K, are soldered one on top of the other. The relay, Q, is also

---

¶ *The list of parts given on page 221 includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

soldered in position on the side of the three large condensers, E, F and H.

Wire the amplifier exactly as shown in the picture-wiring diagram in Figure 2, leaving flexible leads for connection to all of the binding posts and the other instruments that are to be mounted on the metal box, W.

After placing the amplifier unit in the metal box, mount the binding posts, Z1 to Z9, the three Truvolt resistors, R, S and T, and the battery switch, U, on their respective insulating panels.

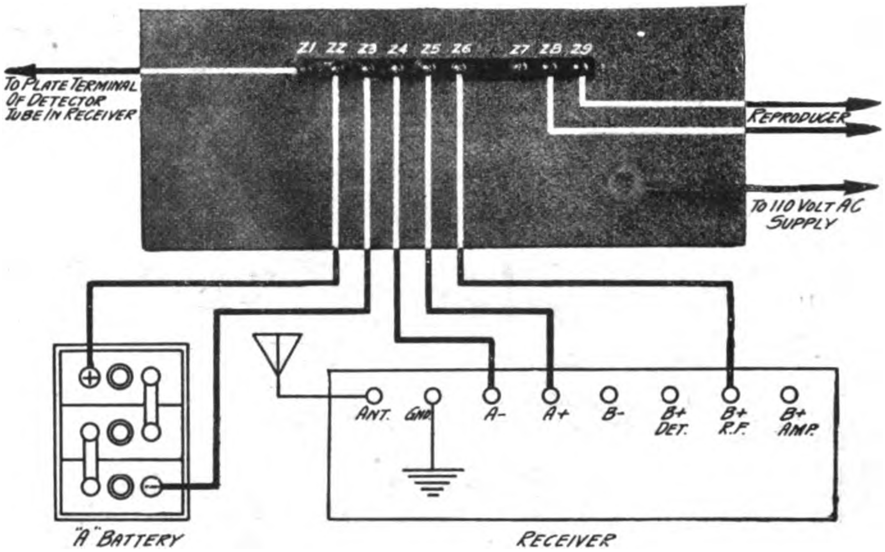
Complete the wiring by connecting the remaining flexible leads to the proper instruments.

How to Install the Amplifier

Figure 3 shows the exact connections to be made between the amplifier unit, the radio receiver and the storage battery. When these connections have been completed, insert a UX-201-a type valve in socket O, a UX-210 type valve in socket P and a UX-216-b type rectifier valve in socket N.

The reproducer which is connected to binding posts Z8 and Z9 should be of the best quality of cone or exponential horn obtainable, in order to insure quality reproduction.

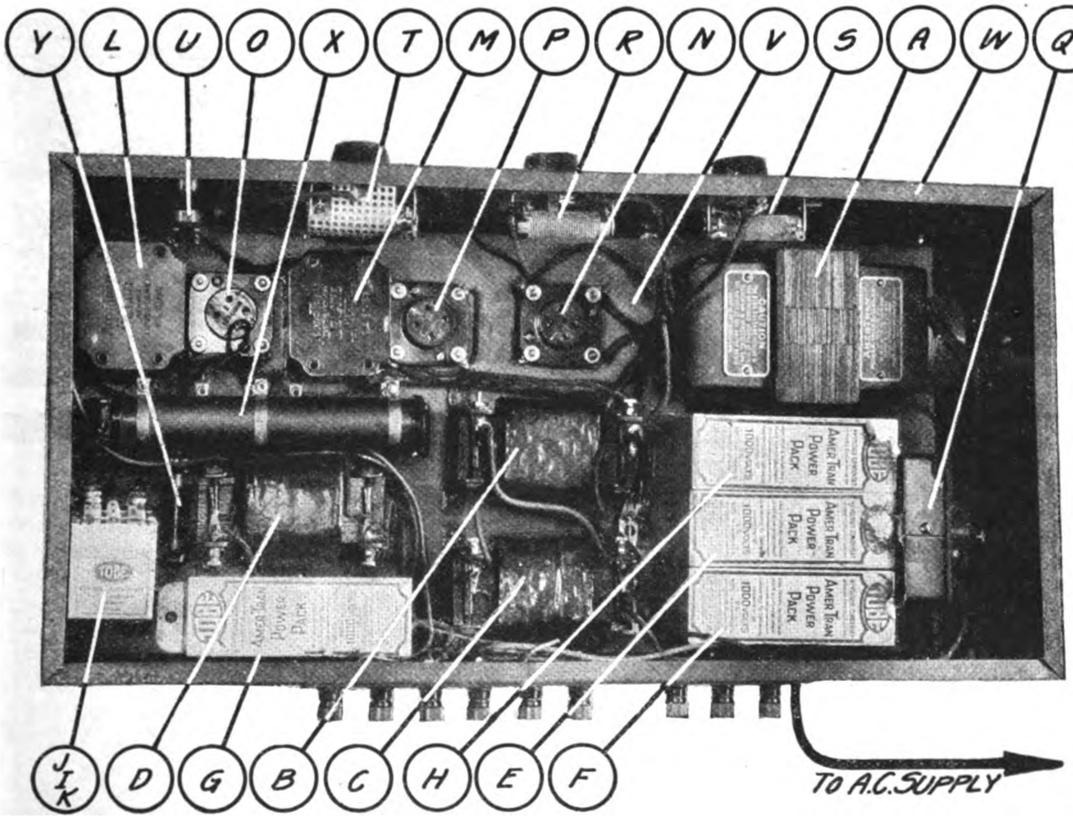
The whole amplifier unit is turned "on" and "off" by means of the small battery switch, U, on the front panel.



HOW TO HOOK UP THE AMPLIFIER

FIGURE 3: *This drawing gives an idea of how this set may be used with any receiver, by cutting out the low-frequency amplifier in the receiver and using the amplifier incorporated in the power-pack amplifier, with excellent results in volume and tone quality.*

The ability of this amplifier to deliver full volume to the reproducer without any overloading should make it very popular with those who want the best in quality reproduction for their homes. In addition, the unit is practically foolproof, as the metal case protects all the instruments, although voltage adjustments may be made with the panel controls. This feature should make it a safe instrument to operate.

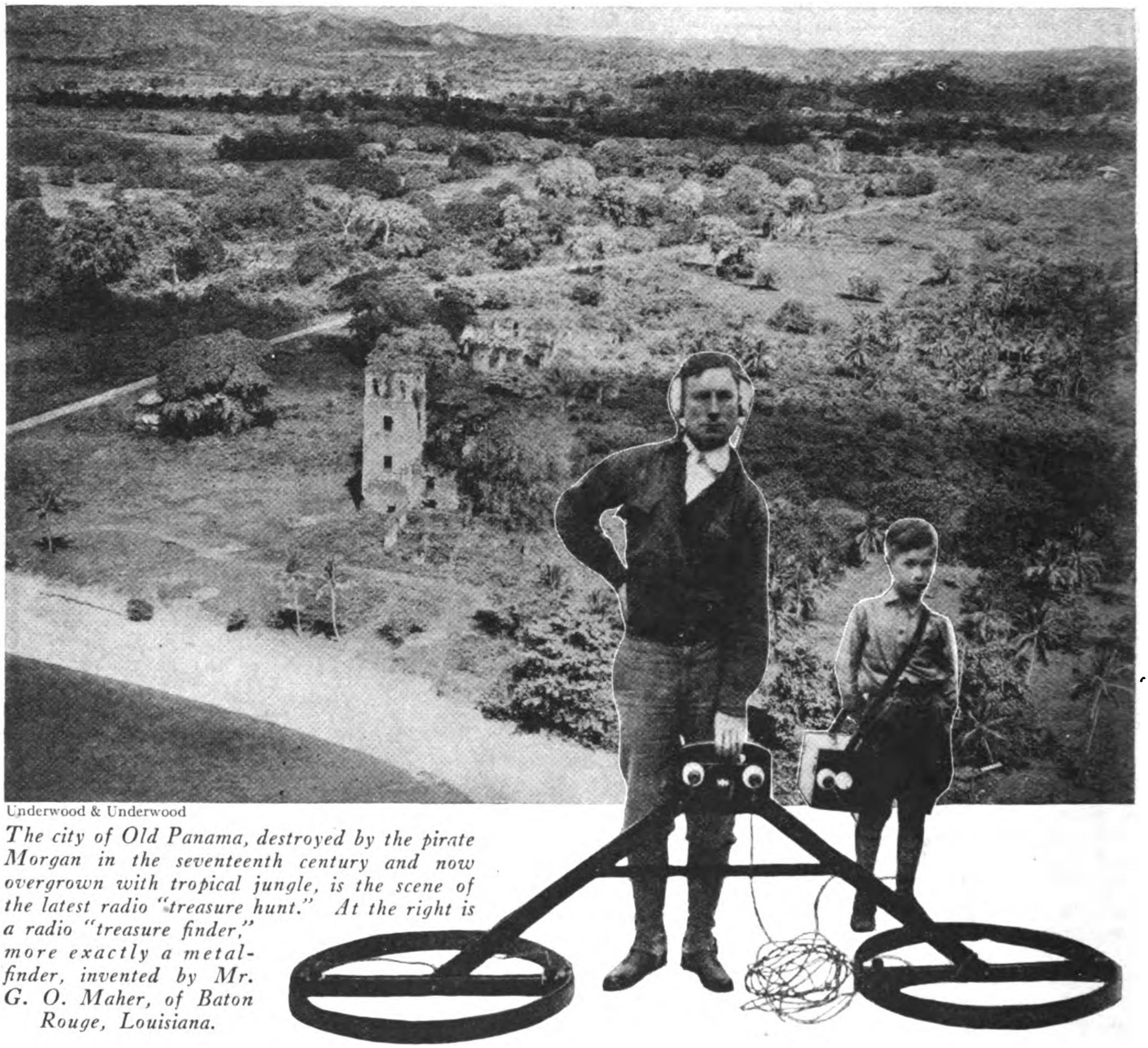


A VIEW OF THE UNIT FROM ABOVE

FIGURE 4: *This view of the power-pack amplifier, with the top of the metal case removed, shows the positions of all of the parts that go to make up this new and powerful unit. All the parts are designated with letters that correspond with the list of parts and the constructional data in the article, so that the prospective builder cannot make any mistake in construction or wiring up.*

Radio Hunts for Buried Treasure

By CAPTAIN PORTER P. LOWRY, U. S. A.



Underwood & Underwood

The city of Old Panama, destroyed by the pirate Morgan in the seventeenth century and now overgrown with tropical jungle, is the scene of the latest radio "treasure hunt." At the right is a radio "treasure finder," more exactly a metal-finder, invented by Mr. G. O. Maher, of Baton Rouge, Louisiana.

NOW radio is being invoked to search for buried treasure.

This treasure, according to belief, is buried in one of the world's most romantic regions—a region that is haunted with memories of pirates, of underground passages, of secret hiding places of immense sums of gold that belonged to the old Inca emperors and to the priests—the city of Old Panama, in Central America.

The city of Old Panama is one of the oldest settlements on the American continent. In 1671 this city was sacked by the English privateersman, Sir Henry Morgan. The amount of treasure found proved much less than the English invaders had expected. There is reason to believe that it was less than the city held; for Panama was an important way station on the great commercial route between Peru and Spain—the route along which there poured back for centuries into the coffers of the Spanish king the gold and gems which were the spoil of the great Inca Empire of South America.

It has long been believed that Sir Henry Morgan's disappointment was not accidental. The citizens of Old Panama had warning of the raid. There have been many stories in the last three hundred years of how the great Spanish families of the time hurriedly buried their ancestral treasures here and there about the city. One of the most circumstantial of these legends tells of how the priests of the cathedral carried into a convenient subterranean passage their store of gold and jewels; not merely the treasure of the church itself, but the collected treasures of many of the wealthy families. This underground storehouse was never found. The priests were captured and put to death, but the secret was kept. Whatever the worthy Fathers may have known went with them to their graves.

No tale such as this could go for long without investigation. There have been innumerable attempts to find the famous underground passage or to discover this or that other cache of precious metals reported to exist somewhere beneath the foundations of the present city of Panama.

Doubtless some of these caches have been found; it is recorded that from time to time impecunious citizens, not known to be possessed even of visible means of support, have turned up temporarily wealthy.

The latest effort to obtain these buried treasures on a larger scale is the one which involves radio.

Some months ago there came to Panama Lieutenant George Williams of the British Naval Reserves; with him are Commander David Blair and Lieutenant F. W. Keally, both of England, and Mr. Wallace Bain, of the United States.

Another member of the expedition is a piece of radio apparatus, said to be the invention of Mr. Thomas Fahie, of Colchester, England. Using this radio apparatus, Lieutenant Williams is attempting to locate some of the buried hoards of precious metal.

Even the most industrious of treasure-seeking expeditions could not hope to dig and sift the entire subsoil of Panama. There is no lack of maps, reputed ancient, which show places where one should dig. Certainly they cannot all be right, and it is probable that most of them represent the accumulated fancies of three centuries rather than actual facts. It is the function of Lieutenant Williams' radio apparatus to point out the spots where digging may be worth while.

Treasure and secrecy go together. Just what Lieutenant Williams, his aides and his radio apparatus have succeeded in discovering is still a secret. Some objects have been found, including, it is reported, a golden butterfly, jewel-studded and measuring three inches from tip to tip, as well as an image of the Jewish Ark of the Covenant more than six inches long. The government of Panama employs an official charged with the duty of inspecting and controlling searches after buried treasure. The success of the Williams enterprise has been great enough to induce this official to provide military guard for their further operations. It is a known fact that the expedition is having such remarkable success that an extensive concession has been granted by the Panama government to carry on the work on shares.

The exact method of operation employed with Lieutenant Williams' apparatus has also been kept a secret. From such information as is available it is probable that the principle is the well-known one of feeding into the ground an alternating electric current or radio wave. As readers of POPULAR RADIO are well aware, methods of this kind have been perfected in Sweden for tracing the locations of underground mineral lodes. Any underground material which is more highly conducting electrically than is the general average of the subsoil will deflect the currents or radio waves thus introduced. Such disturbances may be detected and will serve, when conditions are favorable, as indications of just where the conducting material lies.

Gold, like other metals, is an electrical conductor. It is quite probable that buried masses of gold could be detected in this way.

Another method which is likely being used by Lieutenant Williams' apparatus depends upon the detuning effect of underground masses of metal upon a delicately tuned oscillating circuit in the air above the treasure-bearing soil. It was this method that was proposed a year or more ago for use in hunting the supposed treasure of Cocos Island, off the southern coast of Panama. Indeed, it is reported that the method actually was used and proved successful, but that the persons who found the Cocos Island treasure concealed that fact and held on to the treasure, for reasons best known to themselves.

Certain it is that one or more radio methods are being used for this purpose, and probably with reasonable success.

Of course there are difficulties to be solved. One of them is the wetness of the subsoil. It is reported that in the course of the present search diggers broke through into an underground passage, now filled with water. It was a common habit of the priests and grandees of Spanish times to dig such passages, both for purposes of secret communication and also for the sake of safety in the days when cities were ill-policed. No doubt many such passages still exist beneath the foundations of present Panama, as they do beneath virtually every city of the world whose history goes back as far.

If all of these passages are now filled with water, that fact will constitute an enormous handicap to all the radio methods or electrical methods of detecting the presence of gold. The water of the soil is never pure, but always contains sufficient amounts of dissolved salts to render it an electric conductor. While it does not conduct as well as gold and silver, its conductivity is probably high enough to constitute a substantial disturbance in the region of the radio detectors.

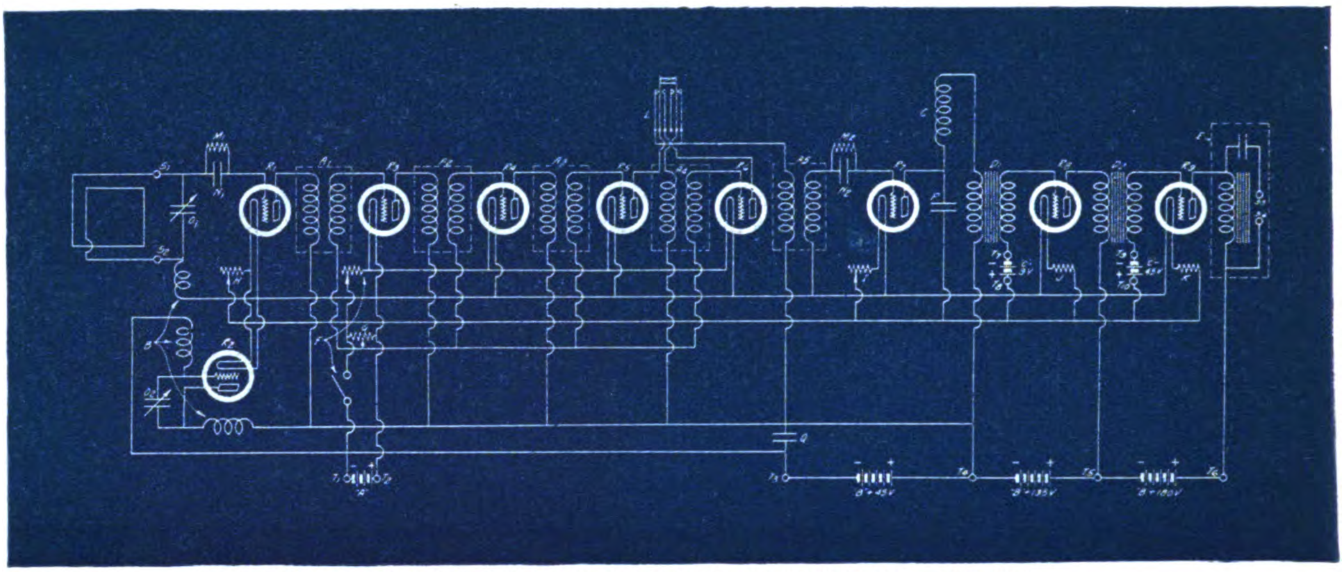
Another difficulty with all radio methods of treasure-finding is the possibility that the precious metals are not in large masses, but are scattered through the soil. Wooden chests in which the ancient Spaniards may have buried their belongings would probably have yielded, years ago, to the tooth of time. The rings and necklaces and other objects which the ancient *señoras* wore, the golden crucifixes or other articles of devotion from the churches, would have escaped from the flimsy wooden walls of their caskets, to lie loosely through the soil. Such loose bits of metal would not be absolutely without influence on

(*Continued on page 258*)

Mr. W. D. Morgan

A DETECTOR FOR USE IN "RADIO GEOLOGY"

Radio methods are being tested as investigators of underground rock conditions, as well as to find supposed buried treasure. This apparatus, used by Mr. W. D. Morgan, of Los Angeles, California, picks up radio waves sent into the ground by the transmitter illustrated on a later page of this article.



THE SCHEMATIC DIAGRAM OF THE MAGNAFORMER CIRCUIT

Figure 1: *The circuit employed is the standard circuit for superheterodyne construction, but the superior merit of the Magnaformer receiver lies chiefly in the excellence of the parts employed—particularly the intermediate-frequency amplifiers.*

HOW TO BUILD

The Magnaformer 9-8 Receiver

Here are the constructional details for building the Magnaformer 9–8 Superheterodyne, whose design and theory of operation were described in the September number of Popular Radio. *This receiver employs eight or nine valves and has great sensitivity when used with a loop antenna.*

By LAURENCE M. COCKADAY

Cost of Parts: *Not over* $129.00, *without the loop*

Here Is the List of Instruments and Accessories Necessary for Building This Receiver—

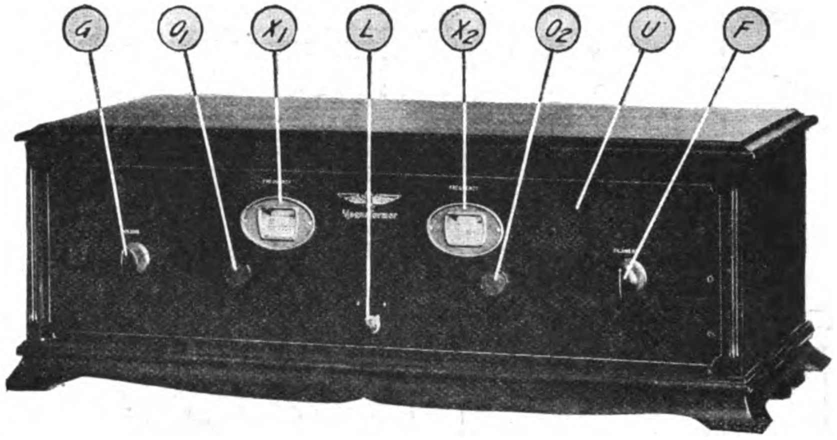
A1, A2, A3, A4 and A5—Magnaformer intermediate transformers, units R. F. No. 61;
B—Unicoupler, unit C. U. No. 71;
C—Samson high-frequency choke coil, No. 125;
D1 and D2—Ferranti low-frequency transformers, A. F. No. 4;
E—National tone filter;
F—Frost DeLuxe combination rheostat, 6 ohms, and battery switch, equipped with gold arrow knob, No. S-1810;
G—Frost DeLuxe potentiometer, 400 ohms, equipped with gold arrow knob, No. 1824;
H—Frost DeLuxe rheostat, 10 ohms, No. 1810;
I—Frost DeLuxe rheostat, 30 ohms, No. 1830;
J and K—Amperites, No. 112, with holders;
L—Yaxley radio jack switch, No. 60;
M1 and M2—Durham 2-megohm grid-leaks;
N1 and N2—Sangamo fixed condensers, .00025 mfd., type No. 1475, with grid-leak clips;
O1 and O2—Remler variable condensers, .0005 mfd., No. 639;
P—Sangamo fixed condenser, .001 mfd., type No. 1450;
Q—Sangamo by-pass condenser, 1 mfd., type No. 200, short;
R1, R2, R3, R4, R5, R6, R7, R8 and R9—Benjamin sockets, No. 9044;
S1, S2, S3 and S4—Frost tip-jacks, No. 253;
T—Yaxley cable-connector plug, No. 660;
U—Formica front panel, 7 by 26 by 3/16 inch, drilled and engraved;
V—Formica sub-panel, 9 by 25 by 3/16 inch, completely drilled;
W1 and W2—Benjamin sub-panel brackets, 2 inches high, No. 8629;
X1 and X2—Remler Universal drum-type dials with controls, No. 110;
Y1 and Y2—2-inch, right-angle supports for propping up rear of sub-panel;
Wire, screws, lugs, nuts, bolts, solder.
Quali-Tone loop—Duro Metal Products Co.
2 Wood blocks for sub-panel center support, 5/8 by 5/8 by 2 inches.

RADIO fans who are superheterodyne enthusiasts will want to build this new and ultra-modern loop receiver, for with it they will be able to accomplish excellent reception from a loop antenna, both as regards distance and quality of tone.

As told in the advance article in last month's issue of Popular Radio, the receiver is a real engineering feat, and contains many new and original features that make its results possible.

To summarize briefly, the receiver contains four stages of high-gain amplification which may be converted at will to three stages for local work. It has two tuning controls and adequate adjustors for obtaining the proper operation of each valve used in the set. Both of the tuning controls work with drum dials that are illuminated.

The construction is simple, as all the parts are mounted on an insulated baseboard or the front panel itself.



THE RECEIVER INSTALLED IN ITS CABINET

FIGURE 2: *All the tuning is accomplished with the two controls, O1 and O2, while the knobs, F and G, provide complete control over sensitivity and volume. A turn of the switch, L, introduces into the circuit an extra stage of intermediate-frequency amplification for distance work.*

The low-frequency end of the receiver contains two stages of transformer-coupled amplification, with an output filter device that protects the reproducer and maintains the quality of tone.

A study of the circuit diagram as shown in Figure 1 will reveal the fact that the oscillator is coupled directly to the grid-circuit of the first detector. The strength of the oscillator output is controlled by a rheostat that enables the greatest sensitivity to be obtained. A switch is included in the valve circuit just preceding the second detector that cuts "in" or "out" one high-frequency stage of amplification of the intermediate amplifier. A high-frequency filter is included in the output circuit of the second detector valve to keep unwanted high-frequency currents from the low-frequency amplifier. The proper "C" batteries are also included in the circuit for the valves in the low-frequency stages.

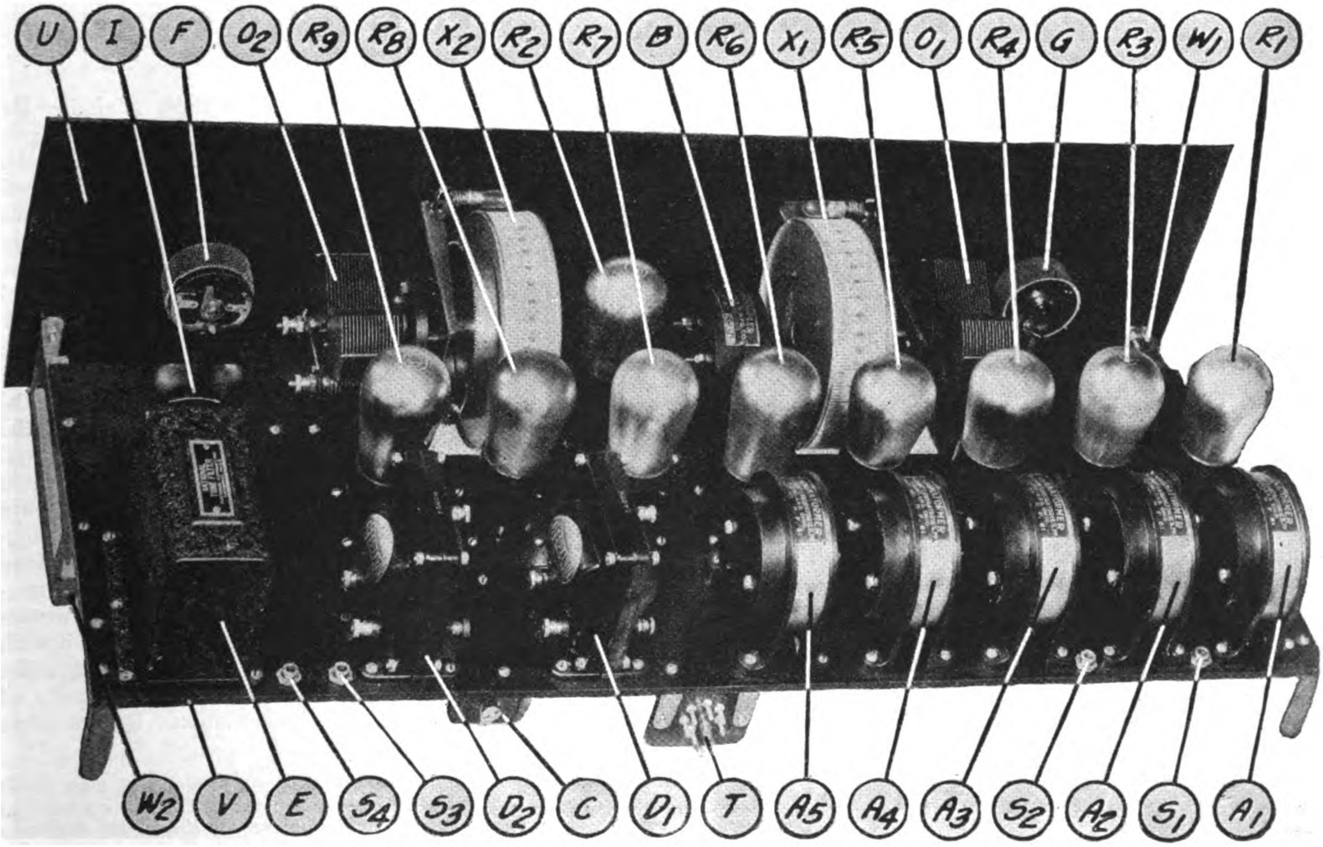
The illustration shown in Figure 2 gives an idea of the appearance of the completed set when installed in its cabinet.

How to Assemble the Receiver

The assembly of the receiver is simplified by the fact that both the front panel and the sub-panel come completely drilled. The front panel is also engraved with the designations for the various tuning controls.

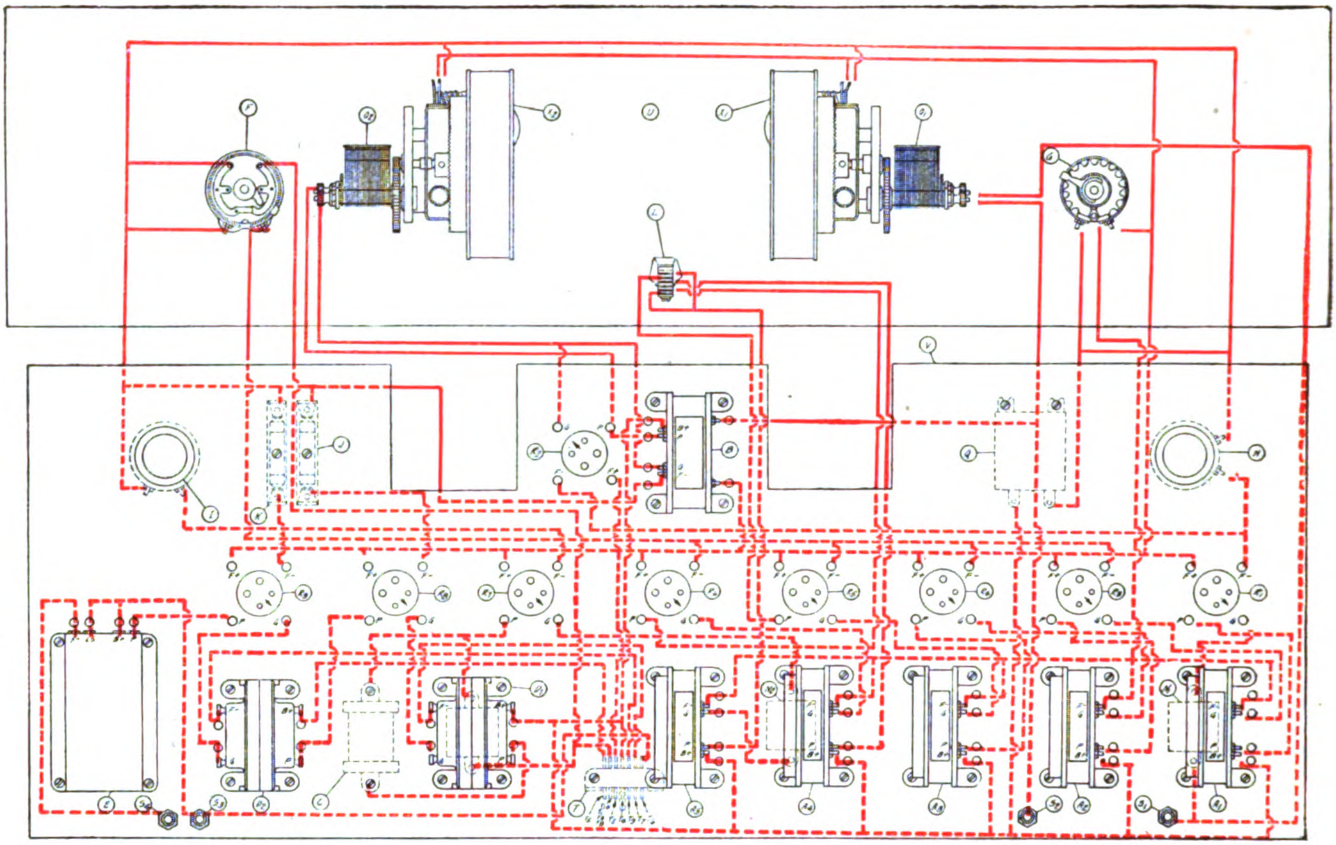
In starting to build the set, the rheostat, F, and the volume control potentiometer, G, should be mounted on the panel in the positions shown in Figure 2. The jack, L, is also mounted, with its framework toward the top of the front panel.

The condensers and drum controls must be assembled before they can be mounted on the panel. The assembly is accomplished by first mounting the variable condensers, O1 and O2, on the flat surfaces of the brass frames which accompany their respective drum controls. This mounting is accomplished by means of three screws which project through from the inside of the brass



THE SUB-PANEL ARRANGEMENT OF THE RECEIVER

FIGURE 3: *The construction of this receiver is greatly simplified by the fact that the sub-panel may be purchased completely drilled; this relieves the builder of much tedious work. The five Magnaformer coils are at the right, the output filter and the low-frequency transformers at the left.*



THE PICTURE-WIRING DIAGRAM OF THE RECEIVER

FIGURE 4: *The instruments above the sub-panel are outlined in solid* BLACK *lines; those beneath the sub-panel are outlined in dotted* BLACK *lines. The wiring above the sub-panel is indicated in solid* RED *lines, while the connections beneath the sub-panel are shown in dotted* RED *lines.*

plates and extend into the tapped legs of the condenser frames. The drums are then slipped over the shafts of the condensers until the worm gears at the rear of the brass plates mesh with the circular flanges on the drum dials. The set screws on the bushings of the drums are then tightened onto the condenser shafts, and the complete units may be mounted on the front panel of the receiver. Only one screw is necessary for each of these mountings, as a single-hole mounting which extends through the panel is provided on each of the control shafts, these serve to hold one end of each of the units firm.

There is no necessity for a detailed description of the mounting of the instruments on the sub-panel. It is only necessary to place the various instruments in the positions indicated in Figures 3 and 4. It will be found that the holes provided in the sub-panel correspond exactly with the mounting holes in the instruments themselves, so that the mounting screws may be inserted without any difficulty.

It is advisable, before mounting any of the instruments, to mount the brackets, Y1 and Y2, on the under side of the sub-panel, and also the small wood blocks which support the middle of the sub-panel. This will keep the baseboard up off the table, and will prevent damage to the instruments mounted on it.

The three small fixed condensers, N1, N2 and P, should be mounted underneath the sub-panel before the other instruments are attached. This is necessary because the heads of the mounting screws for these units are located under instruments which are to be mounted on the top of the sub-panel.

The balance of the sub-panel assembly may then proceed in any convenient order; but it is recommended that the seven transformers be mounted last, as this will make the panel easier to handle and, at the same time, minimize the possibility of damage to the instruments mounted on it. Upon completion of this job, the receiver is ready to be wired.

The front panel and sub-panel should not be fastened together as yet. A good deal of the wiring may be completed before this is necessary, and the work of soldering will be simplified by following this method of procedure.

How to Wire the Receiver

The kind of wire used in making the connections is left to the choice of the individual constructor. In the model receiver shown in the illustrations, three types of wire were used, including bare bus wire, Celatsite bus wire, and flexible Celatsite wire. In the case of long leads that have several branch connections made to them, the bare bus wire is convenient, inasmuch as these branch connections can be soldered to any point along the wire without the necessity of removing the insulation. On the other

---

¶ *The list of parts given on page 226 includes the exact instruments used in the unit from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

hand, the flexible wire is somewhat easier to work with and is equally satisfactory from the electrical standpoint.

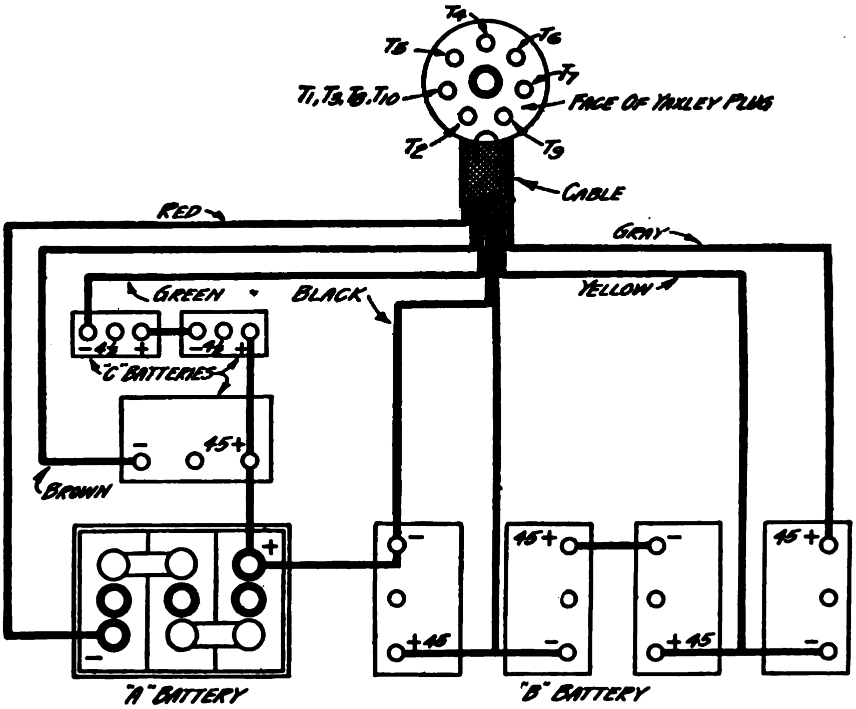
Starting first with the sub-panel wiring, it is a good plan to wire up the terminals of the valve sockets first. This should be done because these terminals are flush against the lower side of the sub-panel and, therefore, most of these connections should be run close to the panel. The plate connection to the socket, R5, and the connection to the jack, L, can be delayed until after the front panel has been attached to the sub-panel. In all cases where connecting wires extend from instruments beneath the panel to others on top, the wires should be run under the panel and then brought through the panel at a point directly beneath the above panel terminal. This gives an extremely neat appearance to the completed set.

The balance of the connections between the other instruments on the sub-panel should now be made, with the exception of those that extend to the front panel. The front panel may then be attached to the sub-panel and the wiring between the two panels completed.

There are no tricks about the wiring, and it is so clearly shown in the picture wiring diagram in Figure 4 that there is no necessity for further instructions.

How to Install the Receiver

Figure 5 shows the detailed connections for the free ends of the battery cable, which provides a means for connecting all batteries to the receiver. It is advisable to make these connections before the plug on the cable is connected to the plug-base on the sub-panel of the receiver.

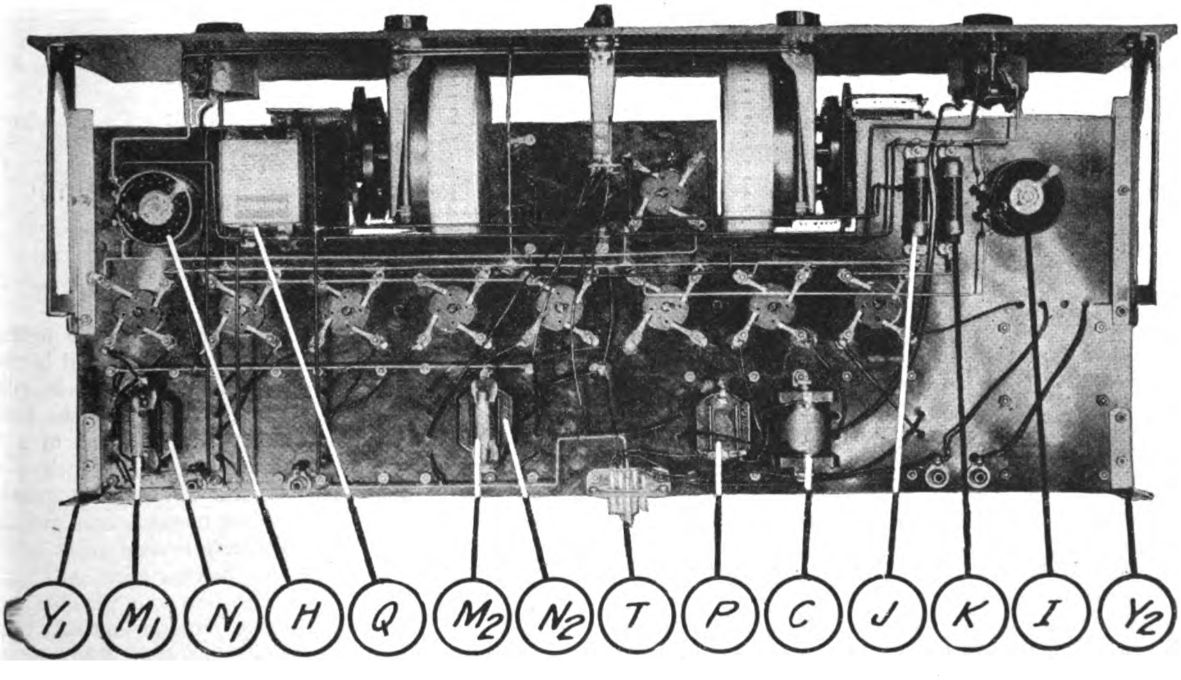


THE BATTERY HOOK-UP FOR THE RECEIVER

FIGURE 5: *When the batteries have been connected to the battery cable as shown in this diagram, and the cable plug has been inserted in the plug socket on the sub-panel of the receiver, the batteries need no further attention except for replacement.*

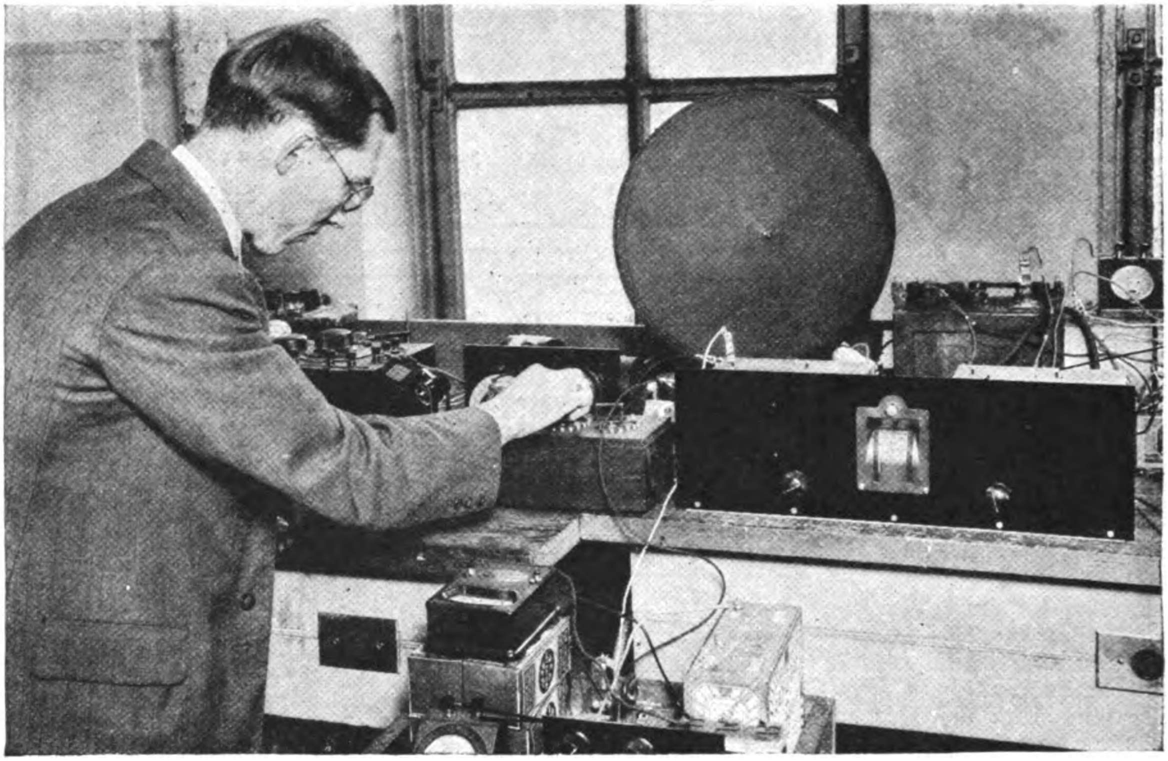
Now, turning to the receiver, the filament-control knob at the right-hand end of the front panel should be turned all the way to the *left*, as should the knobs of the two rheostats mounted on the sub-panel. The small switch at the bottom center of the front panel should be set with its set-screw pointing toward the figure "8." Now insert UX-201-a

(*Continued on page 257*)



A VIEW OF THE SUB-PANEL FROM BENEATH

FIGURE 6: *Nearly all the wiring of the receiver is done beneath the sub-panel, thus improving the outer appearance of the receiver. This view shows how several various kinds of wire were employed in the laboratory model—bare bus wire for long leads with several branches, and flexible wire for shorter connections.*



From a photograph made for POPULAR RADIO

MAKING THE FINAL TESTS ON THE HI-Q RECEIVER

Here is D. K. Oram, the Hammarlund engineer, testing the completed model of the Hi-Q receiver in the Hammarlund laboratory. This is the last of a long series of tests made to determine the exact operating characteristics of this set.

ADVANCE INFORMATION ABOUT

The HI-Q RECEIVER

Here are told some significant facts about this new receiver, the constructional details of which will be given in the November issue of POPULAR RADIO. The set will consist of three stages of high-frequency amplification, shielded and utilizing a carefully designed and balanced method that gives equal amplification over the entire range.

By RAYMOND F. YATES

IF a careful analysis were made of the trend of home-built receiver design during the past two years, it would show that many of the receivers which have become accepted as the very popular, due to their general excellence of performance, employ circuits of a similar nature. For instance, in the Browning-Drake receivers, the LC-26 receiver, the Hammarlund-Roberts set, the Samson T-C, and many others which space prevents a detailed mentioning, the circuits are generally alike, differing perhaps only in the method of neutralization employed in the high-frequency amplifier. All of these circuits have for the tuner end a single stage of tuned-high-frequency amplification, followed by a regenerative detector.

In the early years of their use it was felt that a single tuned stage of high-frequency amplification, if properly built and perfectly stabilized, would produce results which would be on a par with that of the popular neutrodyne circuit. While this is absolutely true, engineers realized the difficulties which confronted the average set builder in duplicating the work of skilled mechanics in radio laboratories. Then, too, there was the realization that even though a most exact duplication was possible, the chances were that improper or incomplete neutralization of a high-frequency amplifier might nullify all the advantages to be gained by its use.

Many changes have taken place in the past three years, not the least important of which are those of a purely economical nature. The prices of individual parts which go to make up a radio receiver nowadays are much lower than they were several years ago. This feature has had its effect on circuit design because now it is possible to build a multistage receiver and still keep the cost within limits of the average set builder's pocketbook. In the use of a circuit comprising a number of tuned-high-frequency stages it is also possible to duplicate the results attained by the use of a single "high-gain" stage.

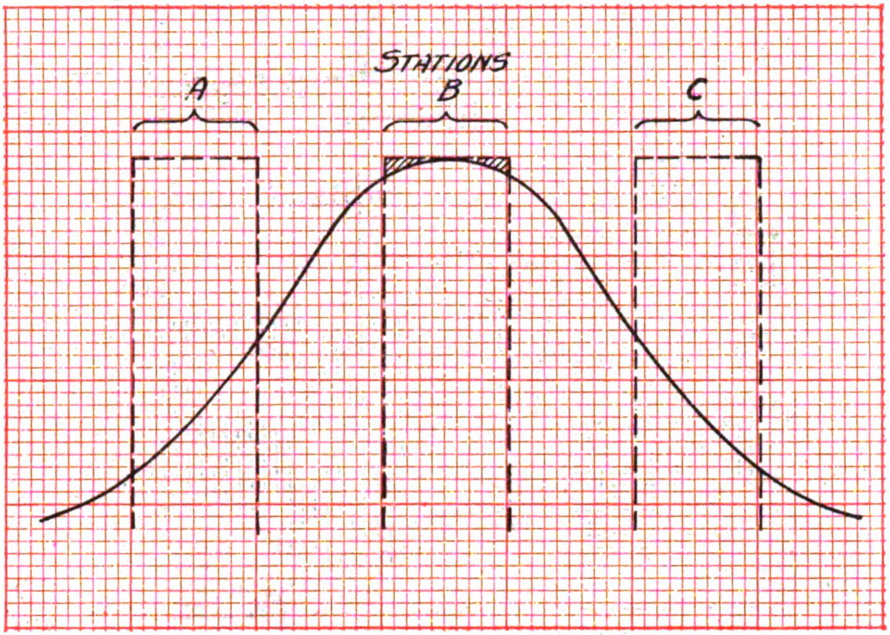
This is particularly true of the new Hammarlund Hi-Q 6-valve receiver which makes its appearance this fall. The engineers responsible for the design of this receiver have had in mind the points outlined here and have succeeded in producing a receiver consisting of three non-regenerative tuned-high-frequency stages, followed by a vacuum valve detector and a low-frequency amplifier employing high quality parts—thus insuring excellent reproduction, both in quality and volume.

The High-Frequency Amplifier

It would be helpful here to make a general comparison of the type of circuit employed in the Hi-Q with the "high-gain" single-stage circuit.

The ideal response curve is shown in Figure 2. It shows that an equal amplification is obtained of all the frequencies within the ten-kilocycle band which is occupied by the signal emanating from a broadcasting station.

In a high-gain single stage of tuned-high-frequency amplification the response curve usually obtained when the circuit is tuned to an incoming signal is illustrated in Figure 3. Note that sharp tuning exists, as manifest by the narrowed tapered top of the curve. Yet when it is considered that to obtain good quality of reception there must be no cutting of the side-bands of the received signal, it is hardly possible to associate this type of circuit with excellent tone reproduction. The shaded section of the curve represents the frequencies within the ten-kilocycle band which are either lost or are amplified to such a low degree that they are practically unheard in the reproducer.

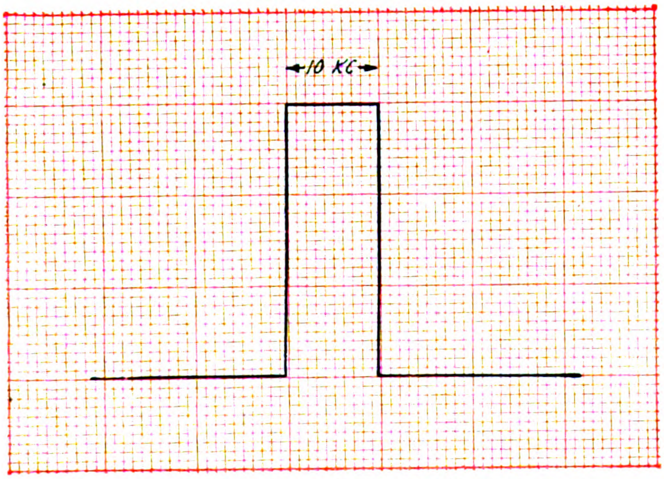


A CURVE THAT ILLUSTRATES BROAD TUNING

FIGURE 1: *This is the type of resonance curve obtained with an ordinary stage of amplification. While it will give good quality of reception on a 10-kilocycle band, a great amount of interference will be encountered, due to its overlapping on outside wavebands, indicated on the curve at A and C.*

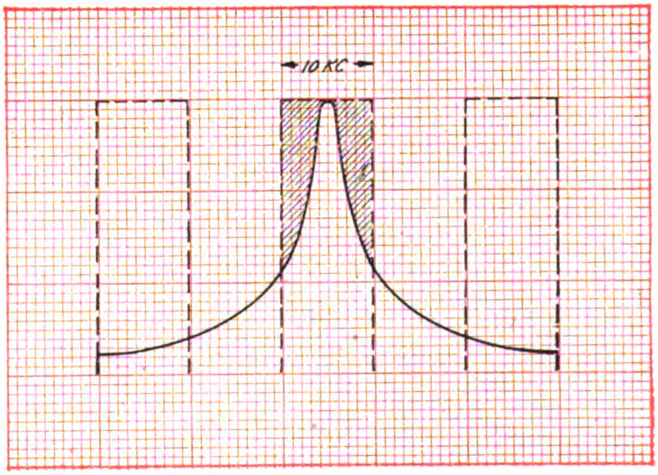
In the hands of experienced operators a higher degree of neutralization might be obtained, which would result in not so great a loss of the frequencies within the band, because the circuit is then less of a regenerative nature than when incomplete neutralization exists. However, perfect neutralization, or anything approaching it, exists only in theory, as far as the average set builder is concerned. It is not to be considered that he is as highly versed in the art as the laboratory technicians who write the constructional information he reads.

Now where a broadly tuned circuit is employed, whose response curve is depicted in Figure 1, it is found that the ideal of equal amplification of all the frequencies within the band is more nearly approached than with the high-gain circuit; but on the other hand there does not exist a similar sharpness of tuning, with the result that stations in near-by frequency bands are heard almost as loud as that to which the circuit is tuned.



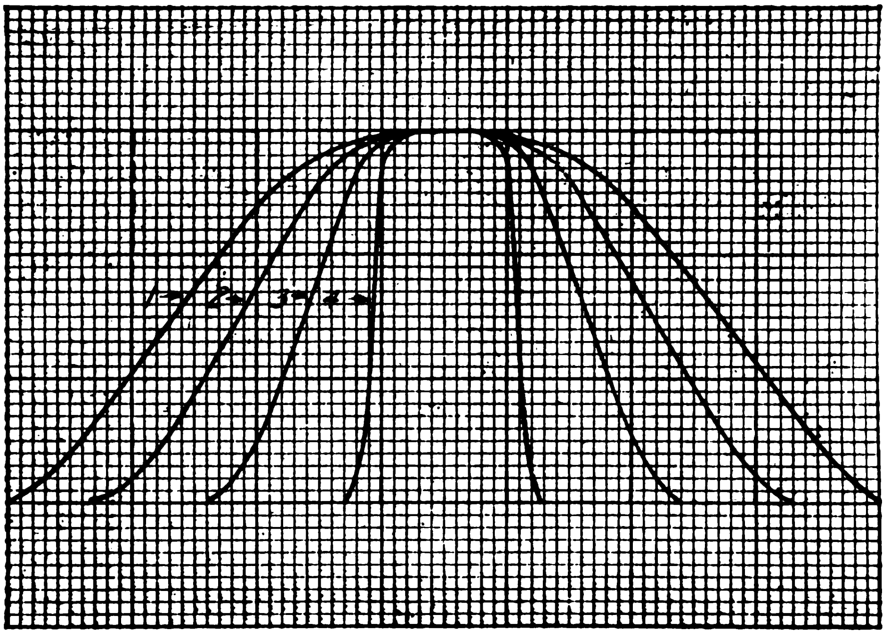
A RESONANCE CURVE SHOWING AN IDEAL STATE OF TUNING

FIGURE 2: *This theoretical resonance curve illustrates a tuning condition that would be ideal under present broadcasting conditions. It would cover the 10 kilocycles necessary for adequate side-band reception without interference from near-by wavelengths.*



A CURVE ILLUSTRATING TUNING THAT IS TOO SHARP

FIGURE 3: *If a receiver had a resonance curve of this type it would be free of interference, but the quality of reception would suffer from the incomplete reception of all those side-bands which are indicated by the shaded portions of the chart.*



HOW THE HI-Q'S CIRCUITS TUNE

FIGURE 4: *These are the respective resonance curves for the four tuning circuits of the new set. Notice that the last stage (No. 4) conforms closely to the perfect tuning stage illustrated in Figure 2, getting all of the side-bands without picking up interference from the two adjacent wavelengths.*

Experimenters have determined through research that when a number of slightly broad-tuned circuits are arranged in cascade formation there is a tendency to retain the flatness of the top portion of the curve, which indicates good quality reproduction, and also a gradual narrowing of the sides of the curve. This point is graphically illustrated in the family of curves shown in Figure 4. It will be observed that where four tuned circuits are cascaded in this manner to form a four-stage amplifier the final curve obtained has the desirable properties of a broadly tuned circuit, together with those that result from the use of a single high-gain stage. In other words, the cascade circuit has resulted in combining quality reproduction with a satisfactory degree of sharpness of tuning—*i. e.*, selectivity—so that there is no noticeable interference from stations in adjacent frequency bands.

This is exactly what has been accomplished in the new Hi-Q receiver.

To further insure the attainment of this goal, it was necessary to incorporate in the circuit a number of protective features which would guard against intercoupling effects between the several tuned circuits. Had not these precautions been taken, it is doubtful whether the results would have proved to be satisfactory.

Intercoupling effects may be produced in a number of ways. First, there may be capacitative coupling between the wires of the several tuned circuits. Secondly, the tuning coils of the several stages may have their electromagnetic fields interlinked so as to cause inductive coupling. Thirdly, resistance coupling might exist, due to a resistance which is common to all the tuned circuits, such as in the "B" batteries.

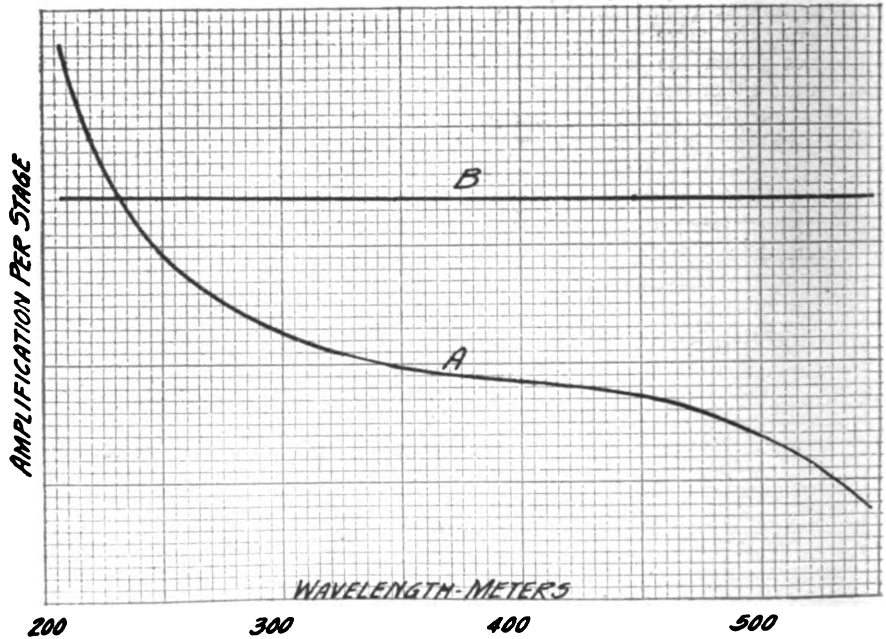
By the use of interstage shields, which effectively separate each of the tuned circuits, and the use of high-frequency choke coils and by-pass condensers, these difficulties have been satisfactorily overcome. With the use of the shields, chokes and condensers, each of the tuned circuits has been completely isolated so that no intercoupling effects are experienced.

The Hi-Q receiver also has incorporated in it another feature which very effectively overcomes one other bugbear of radio. This feature is a mechanical device which so alters the coupling between the primaries and secondaries of the several tuned stages as to obtain an equal degree of amplification over the entire wavelength band covered by the receiver.

Circuits which are not neutralized and where the coupling between primary and secondary is fixed may operate satisfactorily on the upper end of the tuning scale, but when tuned to the lower wavelength these circuits sometimes go into violent oscillation. On the other hand, if the circuits are adjusted so that no oscillation takes place at the lower wavelengths, it usually happens that the amplification falls off quite rapidly as the dial is turned to the upper wavelengths, unless some other precautions are observed.

By means of cams on the shafts of

(*Continued on page 252*)



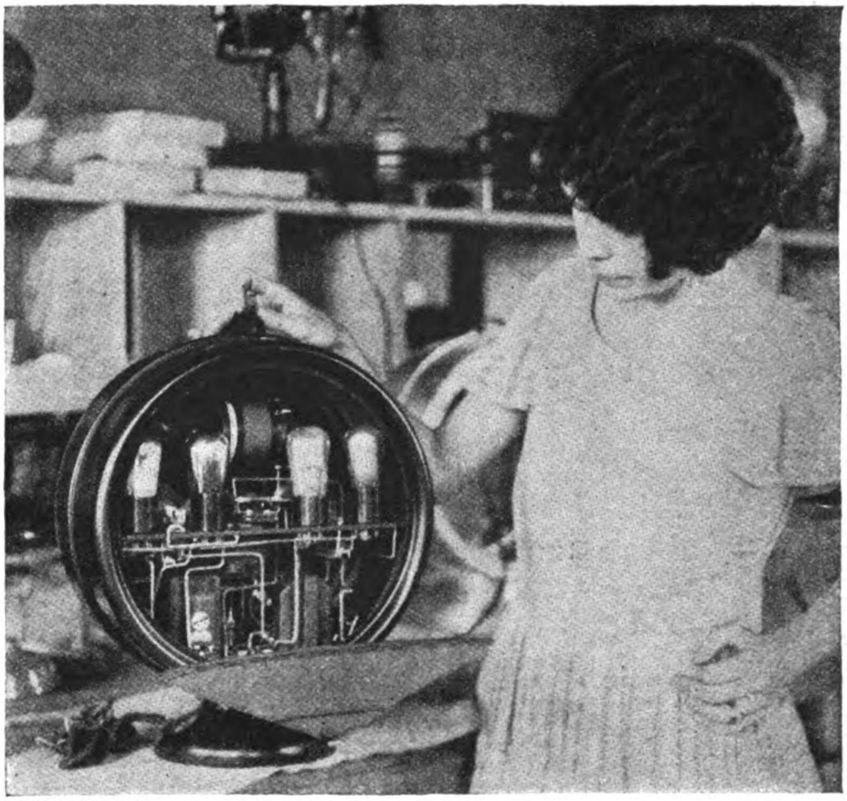
HOW POOR AND EXCELLENT AMPLIFICATION COMPARE GRAPHICALLY

FIGURE 5: *The curve A shows how the amplification of an ordinary tuned-high-frequency receiver varies with the wavelength. Notice that a great amount of amplification is obtained on the wavelengths between 200 and 250 meters; this amplification is frequently unstable, due to excessive regeneration. At 500 meters this same curve drops to a low value. This explains why some sets "squeal" on the lower wavelengths and do not bring in the upper wavelengths. At B is an ideal curve showing equal amplification at all wavelengths.*

What's New *in* RADIO

Conducted by
THE TECHNICAL STAFF

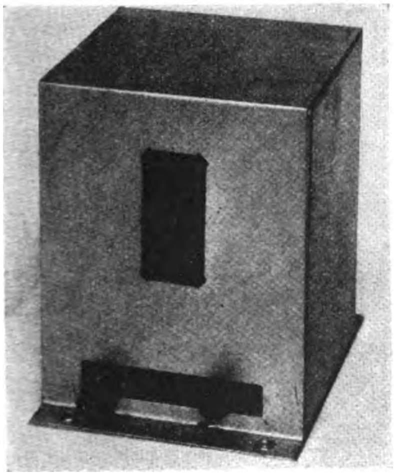
Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY, it will be duly recorded in this Department for the information and benefit of all.



Walter E. Burton

A RECEIVER BUILT INTO A LOUDSPEAKER

This compact little receiver, employing a four-valve regenerative circuit, was designed by V. C. Babcock, of Akron, Ohio. As it weighs only ten pounds, it is easily portable. It is said to give excellent results in quality and volume.



A Filter Condenser that Will Stand High Voltage

Name of instrument: Filter condenser, type 1002.

Description: A metal "can" is used to completely inclose the condenser construction and is filled with an insulating compound to seal in the condenser and provide complete protection from atmospheric conditions. The size of the "can" of the 4 mfd condenser shown in the illustration is 5 1/16 by 4 by 4 inches, exclusive of the mounting flanges at the bottom. Terminals are in the form of flexible, insulated wires which protrude through an insulating strip provided near the bottom of the "can." These condensers are designed for continuous use with direct current voltages up to 1,000 volts. This makes them particularly useful in high-voltage power-packs which provide output voltages of 300 to 500 volts. Such power-packs require filter condensers that are capable of withstanding voltages considerably in excess of the rated output, because the voltages in the part of the filter next to the rectifier are subjected to heavy strains.

Usage: In the filter network of high voltage power-packs. Obtainable in capacities ranging from .1 mfd. up to 6.0 mfd.

Outstanding features: High voltage rating. Capacity within 10 per cent of rated value. Neat appearance. Small size for a given capacity.

Maker: Aerovox Wireless Corp.

Well Constructed Low-Frequency Transformers

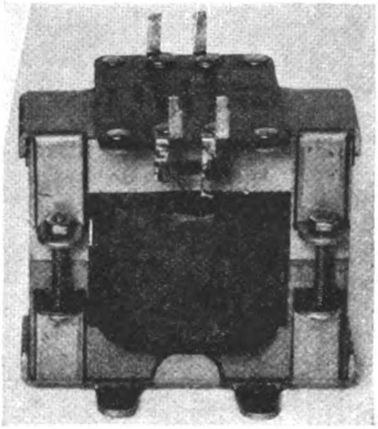
Name of instrument: Kellogg low-frequency transformer, type No. 508. Kellogg insulating (output) transformer, type No. 509.

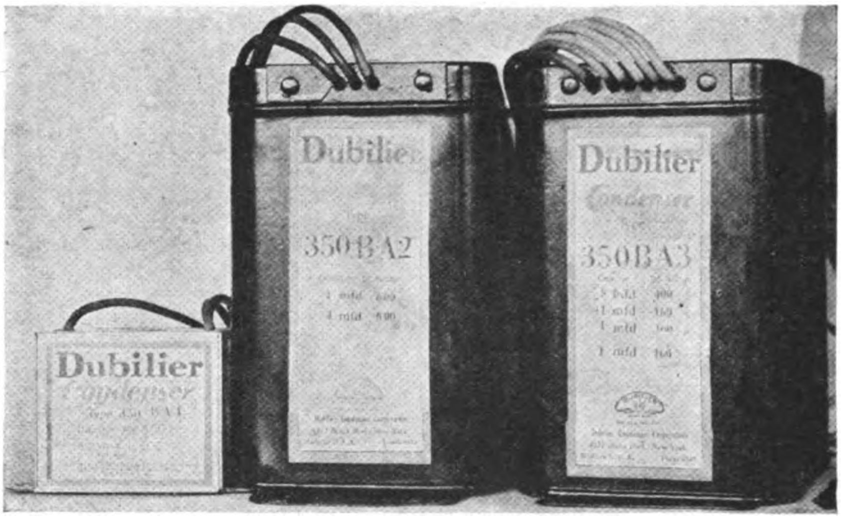
Description: Exceptionally heavy cores and windings are employed in these transformers, in line with the current tendency toward bigger and better transformers, with the resulting better quality of musical reproduction. None of the size and weight is in a metal case and sealing compound, for these transformers are of the open type. The laminated core is solidly clamped on all outer sides by heavy metal stampings, which are attached by means of bolts that exert a considerable pressure on the laminations. Extensions on these metal stampings provide the mounting feet, which are drilled to accommodate the four mounting screws. There are also extensions to which is attached the composition terminal panel. Terminals take the form of soldering lugs. The entire windings are thoroughly impregnated with wax to make them solid and moistureproof.

Usage: Type No. 508 is for use as the coupling transformer in a low-frequency amplifier. Type No. 509, which is identical in appearance with type No. 508, is made for use in the plate circuit of the last low-frequency amplifying valve, to insulate the reproducer from the high-voltage direct current present in this circuit.

Outstanding features: Solid construction. Large cores. Coupling transformer ratio 3 to 1.

Maker: Kellogg Switchboard & Supply Co.





This Condenser Block Simplifies "ABC" Power-Pack Construction

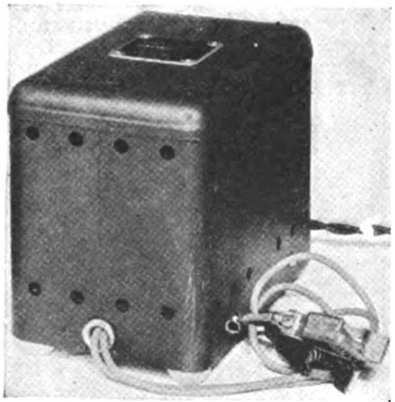
Name of instrument: Series 350-BA condenser block group for Raytheon "ABC" light socket power unit.

Description: This group of condensers is divided into three sections and is assembled in three "cans," as illustrated. These are known as type Nos. 350-BA1, 350-BA2 and 350-BA3. It provides all of the numerous capacities required in the construction of an "ABC" power-pack. If all of these condensers were assembled in a single "can" it would be cumbersome in size and would involve the use of long leads running to all parts of the power unit. By dividing the capacities into sections according to their locations in the circuit the construction of the power-pack can be much simplified and a more evenly balanced layout can be obtained. The various condensers are carefully designed to withstand voltages considerably in excess of those to which they will normally be subjected and these voltage ratings are scaled according to the function and use of the particular capacities. For instance, the condensers used in the transformer secondary circuit and immediately following the rectifier are rated at 600 volts, while the last filter condenser, where the voltage is lower, is rated at 400 volts. The output condensers are rated at 160 volts, as the output voltages across which these condensers are connected are 90 volts or less. The heavy metal "cans" serve not only to protect the condensers mechanically, but they also serve as electrostatic shields. Terminals are made with flexible, insulated wires which may be connected directly to the proper points in the circuit of the power-pack.

Usage: To provide all the capacities necessary in the construction of a Raytheon "ABC" power-pack or other "ABC" power-pack of similar characteristics.

Outstanding features: Well constructed. Carefully designed to withstand the voltages to which they are subjected in this circuit. Sealed in "cans" and thus protected from atmospheric changes, electrostatic coupling or physical damage.

Maker: Dubilier Condenser Corp.



A Battery Charger That Requires No Attention

Name of instrument: Elkon 3-ampere battery charger.

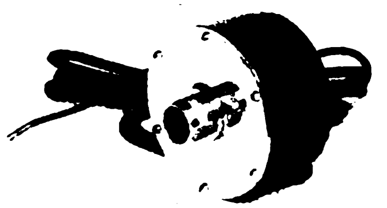
Description: This charger consists of a step-down transformer and a rectifier unit, both inclosed in a perforated metal case. It is provided with an extension cord to be plugged into any convenient 105-120 volt, 50-60 cycle light socket and with two insulated wires that terminate in spring clips, for attachment to the battery to be charged. The rectifier unit used is a new "dry" type that requires no attention whatsoever. The rectifier operates entirely without noise.

It is usually advisable to have some sort of audible or visible indicator in connection with battery charging, and for this reason a small pilot lamp has been included in the charger case. This remains lighted as long as the charger is in operation. The charging rate, if the battery being charged is low, is approximately 3 amperes per hour. As the battery becomes charged this rate tapers off to less than 2 amperes.

Usage: For charging storage batteries from alternating current lines.

Outstanding features: Noiseless. Requires no attention. Practically indefinite life. Tapering charging rate.

Maker: Elkon Works, Inc.



A New Unit for Rejuvenating Old Loudspeakers

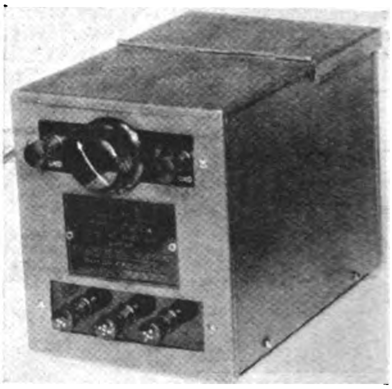
Name of instrument: Operetta reproducer unit.

Description: This reproducer unit is of high quality construction and intended for use with horn type reproducers. It is of standard inclosed construction. The body is finished in ebony and the top in highly polished nickel. The unit is permanently adjusted at the factory and requires no attention after it has once been attached to a horn. It is equipped with metal-tipped extension cord.

Usage: As the reproducer unit in a horn type reproducer.

Outstanding features: Good quality of reproduction. Well constructed.

Maker: Victor Radio Corp.



A "B" Power-Pack for DC Wired Homes

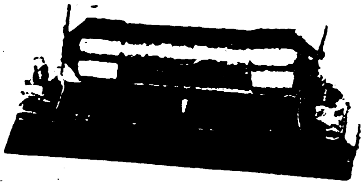
Name of instrument: DC power-pack for "B" voltage supply.

Description: This "B" power-pack is designed for those whose homes are equipped with direct-current lighting supply, but who wish to eliminate "B" batteries. The unit is rectangular in shape and measures 4¾ inches wide by 7¼ inches long by 5½ inches in height. It includes the necessary resistances and filter to provide pure, non-fluctuating direct current for the operation of a radio receiver. There are two output voltages. The high voltage is approximately 105 volts, while the detector voltage may be varied anywhere between 10 and 67 volts by means of the knob on the front of the unit. A device is included in the unit to prevent any possibility of short-circuiting the lighting lines through the ground connection of the receiver. The entire unit is inclosed in a metal case.

Usage: To provide "B" voltage from the 110 volt DC house-lighting lines.

Outstanding features: Contains an isolating device to prevent short circuiting of light lines. Variable detector voltage. Neat appearance. Requires less space than a heavy-duty "B" battery.

Maker: Chamberlin Electrical Co., Inc.



A Filament Control that Increases Valve Life

Name of instrument: "Polytrol" automatic filament control and mounting.

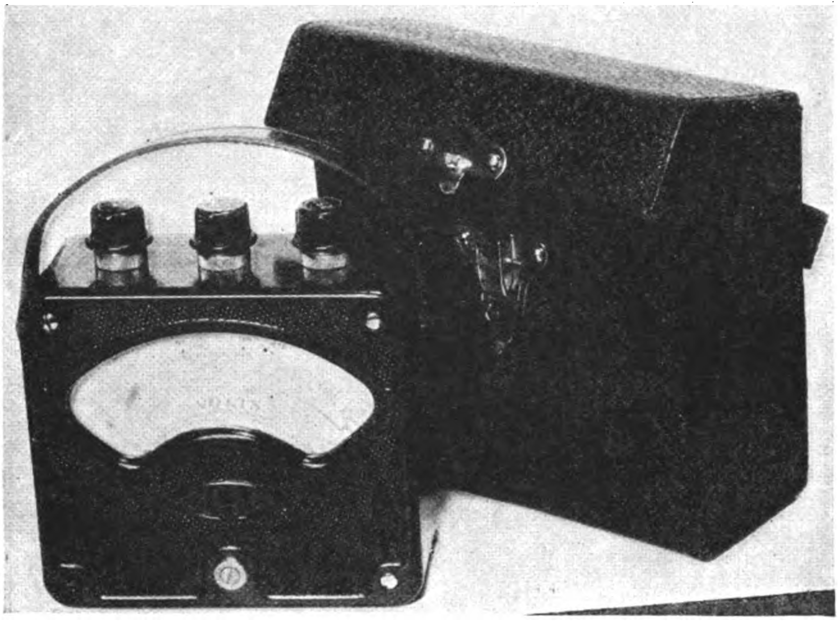
Description: The resistance of each Polytrol unit is sufficient to reduce the battery voltage to that required by the valve or valves which the Polytrol is to control. This electrical element is inclosed in a glass tube and metal ferrules are mounted on the ends for making contact with the mounting clips.

These units are made in several values to match the current requirements of different valve filaments.

Usage: To reduce the filament supply battery voltage to that required by the valve or valves used. The type of Polytrol used will depend on the type and the number of valves it is to control.

Outstanding features: Controls the current to be supplied to the filament of each valve in a receiver, without any attention or manipulation on the part of the operator.

Maker: Polymet Mfg. Corp.



An Accurate Voltmeter for "B" Power-Packs

Name of instrument: Westinghouse high-resistance voltmeter.

Description: This meter provides an excellent means for measuring the output voltages of "B" power-packs, as its resistance is 1000 ohms per volt. It is a recognized fact that the ordinary voltmeter is of little use for this purpose because its comparatively low resistance alters the value of the output circuit to which it is connected. This meter has two ranges, 0-250 volts and 0-50 volts. For measuring "detector" and "C" voltages the two left-hand binding posts on the top of the meter are used for the connections. These provide full scale deflection at 50 volts. These readings are made from the lower scale on the face of the meter. For the 250-volt range the two outside binding posts are used, and the reading is taken from the upper scale. To permit extremely accurate readings the face of the meter is equipped with a mirror to enable the operator to bring his eye directly in front of the indicator needle. The case of the meter is equipped with a strap handle. A leather carrying case, as shown in the illustration, may also be obtained at an additional cost.

Usage: For measuring direct-current voltages within the range of 0-250 volts. Particularly useful in high-resistance circuits such as the output circuits of "B" power-packs.

Outstanding features: High resistance. Convenient size. Two range, easily readable scale. Zero adjustment. A precision instrument.

Maker: Westinghouse Electric & Mfg. Co.

A Complete Condenser Unit for "B" Power-Packs

Name of instrument: Filter condenser block, Type No. F-1000.

Description: This block consists of several fixed condensers mounted in a single "can" with a total capacity of 14 mfd. This total capacity is divided up into five groups of 1, 1, 2, 2 and 8 mfd. respectively. One side of each of these groups is connected to a separate terminal on the outside of the block to permit making individual connections to each unit. The other sides of all groups are connected together and brought out to a common terminal. The values of the capacities at each terminal are clearly marked on the block.

Usage: To be incorporated in a "B" power-pack to supply all the various capacities required. Especially intended for use with the Raytheon BH rectifier circuit or other circuits with similar voltage ratings.

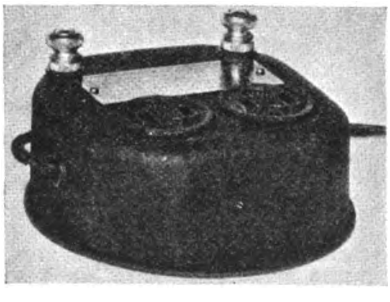
Outstanding features: Compact. Neat. Terminals conveniently located. Easily mounted.

Maker: Polymet Mfg. Corp.

A Combination Switch for "A" and "B" Supply

Name of instrument: Continental Uni-Switch.

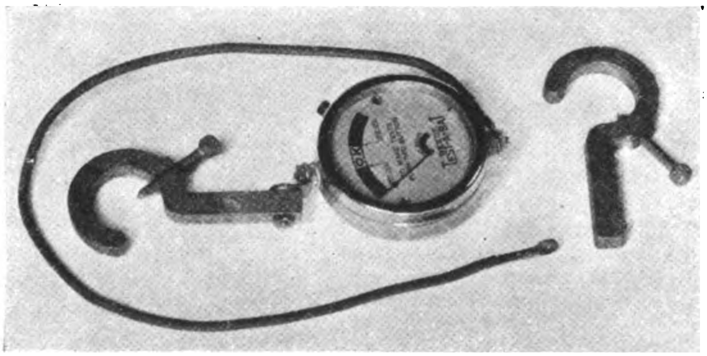
Description: The working parts of this relay switch are enclosed in a neat metal case. Flush with the top of the case are two standard plug receptacles, into which the plugs from the "B" power-pack and the trickle charger may be inserted. There are also two binding posts on the case for connection to the "A" battery and to the receiver. An extension cord and plug are provided for connecting the switch to the AC house-lighting lines. When the battery switch on the panel of the receiver is turned "on" the current from the "A" battery flows through the magnet winding of the relay switch. This trips the relay and causes contacts to be made which connect the "B" power-pack to the house-lighting lines. When the panel switch is turned "off" the relay arm is released. This breaks the line connection to the "B" power-pack and in turn connects the line to the trickle charger. Thus when the receiver is turned "on" the power-pack is also "on," and when the receiver is turned "off" the trickle charger is turned "on" to replenish the current consumed from the battery. The "B" power-pack is at the same time turned "off." The relay unit is neatly finished and is attractive in appearance.



Usage: To provide automatic control of the "B" power-pack and trickle charger used in conjunction with a radio receiver.

Outstanding features: Automatic in operation. Compact in size. Neat appearance.

Maker: Gardiner & Hepburn, Inc.



This Meter Gives an Instantaneous Check on the "A" Battery

Name of instrument: "Test-A-Bat" "A" battery testing meter.

Description: This is a small "watch-case" meter, with its dial marked into three sections instead of being calibrated. These three sections are marked "start charge," "O. K." and "stop charge." The meter is equipped with two metal brackets, by means of which it may be permanently attached to the terminals of a storage battery. There is a button on the side of the meter which may be pressed to obtain the meter readings. The meter is therefore always in position, ready for use, and the condition of the battery is determined instantly by a momentary pressure on the button.

Usage: To test the state of charge of a storage "A" battery.

Outstanding features: Handy to use. Always ready for use. The scale is easily readable, even in a poor light, as when the battery is inside of a console, etc.

Maker: Beede Instrument Co.

A Single Unit That Provides All Filter Capacities for a "B" Power-Pack

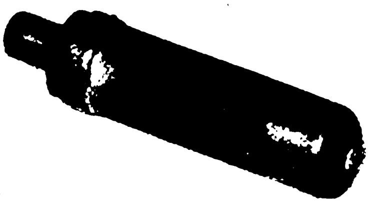
Name of instrument: Filter condenser block, type BH-420.

Description: The metal container which incloses this condenser group measures 5 1/16 by 5 by 2 inches. In it are five condensers of the capacities recommended for use with filters for "B" power-packs which use the Raytheon BH rectifier valve and which provide an output of approximately 200 volts. The first two condensers in this block have a capacity of 2.0 mfd. each and are designed for an operating voltage of 400. The third condenser has a capacity of 8.0 mfd. and, inasmuch as it is subjected to lower voltages than the first two, is rated at 300 volts. The last two condensers serve as by-pass condensers across the low-voltage output terminals of the power-pack; their voltage rating of 200 is adequate for safety. These two have a capacity of 1.0 mfd. each. There are a common terminal and five individual terminals provided on this block. These are flexible wires, heavily insulated, and are intended to be connected directly to the other parts of the power-pack filter.

Usage: To provide all condenser capacities required in a medium voltage "B" power-pack.

Outstanding features: Convenient size and shape. Simplifies power-pack construction by combining five condensers in a single unit. Voltage and capacity ratings adequate for this service.

Maker: Aerovox Wireless Corp.



A Battery Charger Without Bulbs or Liquids

Name of instrument: Two-ampere rectifier cartridge, type BA.

Description: This rectifier consists of a metallic cartridge about the size of a man's index finger. One end of the cartridge is closed with an insulating disc from which a smaller metal cylinder protrudes about ½ inch. The rectification device is based on the principle of rectification obtained through the association of two metals with a non-conducting agent suitably disposed around or between them. It is an entirely "dry" device, inasmuch as it consists of metals and a solid non-conductor. The rectifier unit is entirely inclosed within the metal cartridge. Its efficiency as a rectifier is claimed to be approximately 50 per cent higher than that of rectifiers of the bulb type. When supplied from a step-down transformer of suitable voltage output, this rectifier will provide a rectified current of 2 amperes for battery-charging purposes. Several inexpensive battery chargers which incorporate this rectifier have been recently placed on the market. The 2-ampere chargers consist of a transformer and a single one of these cartridges. Five-ampere chargers consist of a transformer and two of these rectifiers so arranged as to provide full-wave rectification. Mountings consist of two fuse clips into which the rectifier cartridge is inserted like a fuse.

Usage: As the rectifier in a battery charger or for other purposes where a rectifier capable of supplying up to 2 amperes at low voltages is required.

Outstanding features: No liquids or filaments. Requires no attention. Guaranteed minimum life of 750 hours. Either one or two cartridges may be used to provide half-wave or full-wave rectification, respectively.

Maker: Raytheon Manufacturing Co.

A "B" Power-Pack That Works With Any Receiver

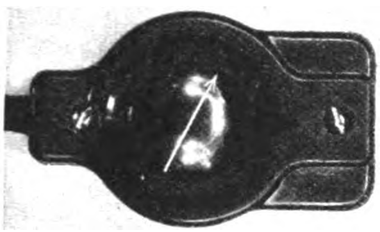
Name of instrument: Little Giant "B-C" power-pack.

Description: This power-pack makes use of a Raytheon BH type rectifier valve and is capable of supplying 180 volts at a normal current drain of 40 milliamperes. It is inclosed in a metal case that is finished in a pleasing brown shade. All output voltages are variable to permit the power-pack to be adapted exactly to the requirements of any receiver and to permit the use of either a UX-112 or UX-171 type power valve in the last low-frequency stage of the receiver. Three "B" voltages are supplied and two "C" voltages. The front end of the unit carries the five control knobs, as shown in the illustration. The rectifier valve is inserted in its position through a hole provided in the top of the case. The unit is equipped with an extension cord and plug for insertion in a lamp socket and a switch for use in turning the power "off" and "on." It is for use where the alternating current light supply is 60 cycle, 110 volts.

Usage: To supply the "B" and "C" voltages to any receiver from the alternating-current lighting lines.

Outstanding features: All output voltages are variable. Neat appearance. Supplies adequate current for the use of a UX-171 power valve in the last low-frequency stage of a receiver.

Maker: Webster Co.



A Volume Control Unit for Any Receiver

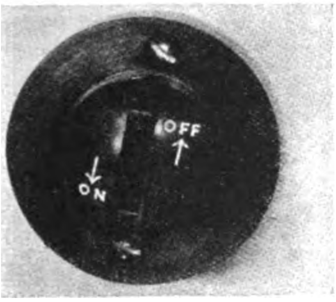
Name of instrument: Centralab Moduplug (modulator plug).

Description: This modulating device is obtainable in two styles. One is similar to an ordinary phone plug, except that it contains a resistance unit and a knob to vary this resistance. The other is the one pictured above. This is furnished with a 30-inch extension cord which is equipped with phone tips for connection to the output binding posts of a receiver. The tips of the reproducer cord are slipped into the spring grips provided in the other end of this plug. When so connected, the volume of reproduction can be varied at will by simply turning the knob on the plug. Either of these units is particularly useful in the case of old receivers which have no adequate provision for controlling volume. Also, in cases where the reproducer may be in a different room from the receiver, the volume can be controlled at the reproducer by inserting one of these plugs in the extension cord.

Usage: For controlling the output volume of a receiver; this control to be operated at the reproducer instead of at the receiver.

Outstanding features: Provides exact control of volume without reducing sensitivity, as is usually the case where volume is controlled in the high-frequency amplifier. Provides variation of output from maximum to zero. Installation involves no alteration in the receiver and no tools.

Maker: Central Radio Laboratories.



A Simple Battery Switch

Name of instrument: Toggle switch, No. 622.

Description: The housing of the switch is of moulded bakelite and measures 1¼ inches in diameter. Its top is engraved with arrows and the words "off" and "on." The toggle lever is also of bakelite and projects through a slot in the bakelite form. The switch is designed for panel mounting and for this purpose requires two small holes in the panel to accommodate the two long screws which extend from the back of the switch. These screws serve not only as the mounting screws, but also as the connection terminals, so that the connection wires need not be brought through the panel. The contact members are of spring brass.

Usage: As a filament switch in a radio receiver or for other light-duty switching purposes where a single-pole, single-throw switch is required.

Outstanding features: Neat appearance. Good insulation. Positive operation.

Maker: Herbert H. Frost, Inc.

A Large Loop with Good Pick-Up Qualities

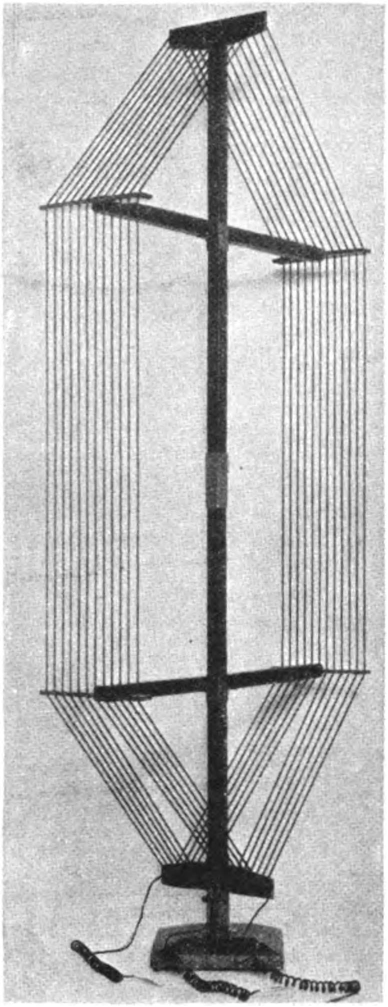
Name of instrument: Loop antenna.

Description: This folding loop measures approximately 46 inches in height by 19 inches across. It is tightly wound with silk-covered loop wire on slotted composition spreaders that are mounted at the extremities of the mahogany framework. Metal parts are of satin-finished brass. The loop frame fits into a socket in the base, in which the loop may be readily revolved. The terminals are in the form of three wires that terminate in metal tips for direct connection to the receiver input binding posts. Two of these terminals are taken from the ends of the loop winding, while the third is a center tap.

Usage: As the antenna for use with especially sensitive multivalve receivers, particularly with superheterodyne receivers.

Outstanding features: Large size and good pick-up. Excellent workmanship, materials and finish. Center tapped. Folds into space approximately 6 inches by 6 inches by 2 feet.

Maker: Mathiesen-Sandberg Co.



A Filter that Insures Long Life for the Reproducer, and Better Reproduction

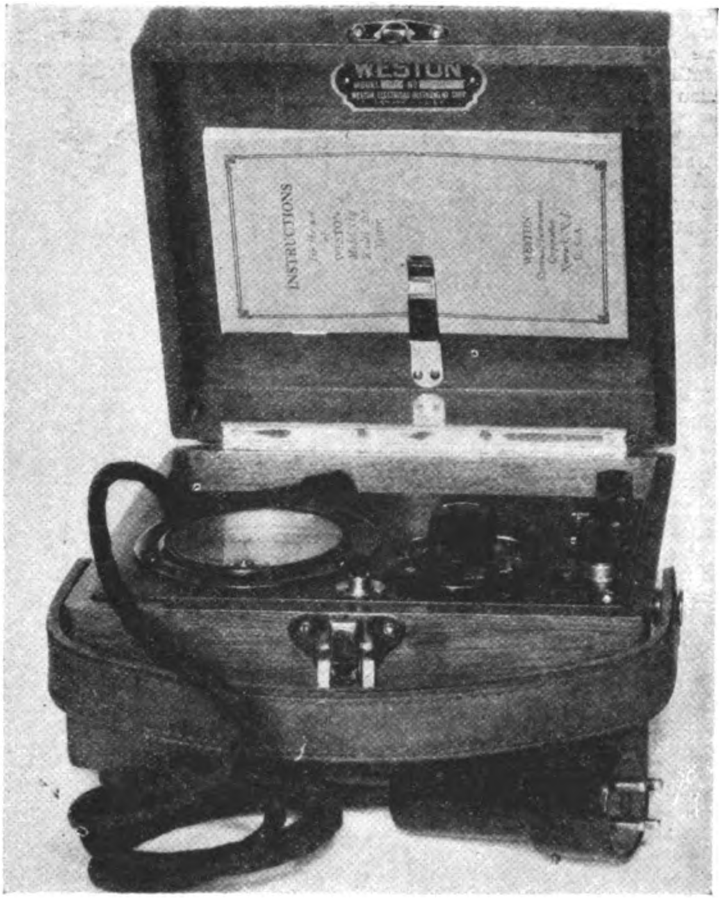
Name of instrument: Erla output filter.

Description: This filter unit consists of a choke coil and a by-pass condenser, so arranged that the direct current in the plate circuit of the power valve of a receiver does not pass through the delicate winding of the reproducer magnets. The alternating current, which is to be transformed into music and speech by the action of the reproducer, is permitted to pass freely to the reproducer. Thus the strain which would be imposed on the reproducer windings by the direct current is eliminated, with the result that the quality of reproduction is improved and there is no chance of demagnetizing the reproducer mechanism. This filter is completely inclosed in a metal case and is provided with two input and two output binding posts. It may be incorporated in a receiver during construction, or may be used externally with receivers already in operation. In the former case the filter is connected directly into the plate circuit of the power valve and the output terminals of the filter are connected to the output terminals of the receiver. When used externally, the output terminals of the receiver are connected to the input terminals of the filter and the reproducer is connected direct to the output terminals of the filter.

Usage: In the output of the power valve that is used in the last low-frequency stage of a receiver, to provide a by-pass around the reproducer windings for the heavy direct current that is present in the plate circuit of such a valve.

Outstanding features: Well constructed. Neat appearance. Easily installed. Improves quality of reproduction. Protects reproducer.

Maker: Electrical Research Laboratories.



Trouble Shooting Made Easy With This Device

Name of instrument: Radio set tester, Model 519.

Description: A single meter is incorporated in this test set, but it serves a fourfold purpose. It has three voltage ranges—0 to 8, 0 to 80 and 0 to 200 volts—and a current range of 0 to 20 milliamperes. On the panel, inside of the case, are mounted, in addition to the meter, an 8-position rotary switch, a valve socket, a small push-button switch and three binding posts. The three binding posts are for use when the instrument is to be used as a straight voltmeter for measuring the voltage of batteries, "B" power-packs, etc. The other devices are used for receiver and valve testing.

As a receiver tester, or "trouble shooter," this instrument presents many advantages. An extension cord with a plug similar to the base of a vacuum valve is provided with the tester. To test a receiver this plug is inserted in one of the sockets of the receiver and the valve which was removed from this socket is plugged into the receptacle in the tester. The other valves in the receiver are left in position and the receiver is turned "on" just as when in normal operation. Then, by turning the testing switch to its various positions it is possible to obtain exact readings of the filament voltage, plate voltage, plate current and grid-bias voltage applied to the valve under test. All of the valves in a receiver can be tested in this manner.

To test valves, the plug of the tester is inserted in a socket in the receiver—preferably one which will provide a plate voltage of 90 and a grid-bias of 4.5 volts. The various voltage and plate current readings are then taken as described above. In addition, the small push-button switch is brought into play. This changes the value of the grid-bias voltage and consequently the value of the plate current if the valve is in good condition. The instruction booklet which accompanies the tester gives complete information on testing valves.

The meter in the tester has a resistance of 1,000 ohms per volt, which makes it suitable for use in taking voltage readings on "B" power-packs, as well as on batteries. This is a particularly advantageous feature, not only because it permits the use of this tester with receivers that employ "B" power-packs, but it enables the operator to adjust his "B" power-pack to the required voltages.

The tester is also equipped with two cords with insulated handles. When using the tester as a voltmeter for testing batteries these cords are connected from the binding posts of the tester to the batteries that are under test.

Usage: For "trouble shooting" in receivers, for testing valves, and for use as a standard, high-resistance voltmeter.

Outstanding features: When used as a set tester, it shows exactly how each valve is functioning in the set. It provides a reliable test on valves. It contains a high-resistance voltmeter, which makes the device suitable for testing power-pack voltages. The unit is inclosed in a neat carrying case which also has a compartment for the accessories and extension cord. It is also equipped with adapters to permit its use with valves of the UX or the UV-201-a type.

Maker: Weston Electrical Instrument Corporation.

A Neat Combination "A" Power-Pack

Name of instrument: Universal "A" supply.

Description: A storage battery, charger and automatic relay switch are combined to provide a self-contained "A" supply unit of convenient size and neat appearance. These devices are inclosed in a crystalline metal container. The storage battery is of sufficient capacity to meet the requirements of any receiver. The charger is of the bulb type and uses a 2-ampere Tungar bulb. There are two charging rates and a toggle switch on the front of the case permits a choice of the two rates. When this switch is thrown to the "high" side the rate is 1½ amperes per hour. On the "low" side the charge is reduced to ½ ampere per hour. Normally the switch is left on the "low" side. This provides sufficient current to maintain a good trickle charge and keep the battery fully charged except in cases where the battery is subjected to unusually heavy drain, in which event the "high" charge should be resorted to occasionally. A receptacle is provided on the front of this unit so that the "B" power-pack, if one is used, may be plugged in, to be operated by the automatic relay switch contained in this unit. Thus, when the receiver is turned "on" by means of its battery switch, the charger is disconnected from the AC line and the "B" power-pack is connected to the AC supply. When the receiver is turned "off" the action of the relay switch is just the reverse.

Usage: To furnish a constant source of filament current for the operation of any receiver.

Outstanding features: Storage battery, charger and automatic control switch all inclosed in a single case. Two charging rates. Supplies constant source of filament current for operation of any receiver.

Maker: Acme Electric & Mfg. Co.

A Tube for General Use

Name of valve: D-Ola.

Description: This valve is of the standard UX-201-a type with a UX-type base. It is interchangeable with any standard valve in a circuit. The base is of isolantite.

Valve rating:

Filament voltage—5.
Filament current—.25 ampere.
Plate voltage—16.5 to 157.5.
Negative grid bias—0 to 9 volts.

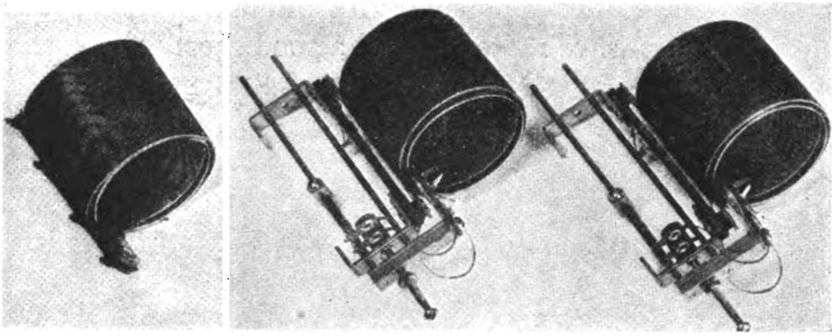
Valve characteristics (with a plate voltage of 90 and a negative grid bias of 4.5 volts), as determined in POPULAR RADIO TESTING LABORATORY:

Plate resistance—10,750 ohms.
Amplification factor—6.6.
Mutual conductance—613 micromhos.
Plate current—3.5 milliamperes.

Usage: As a detector, a high-frequency amplifier or as a low-frequency amplifier.

Outstanding features: Interchangeable with any UX-201-a type of valve in a circuit. Isolantite base.

Maker: DeForest Radio Co.



Precision Made Coils For the Loftin-White Circuit

Name of instrument: Loftin-White coil set, type LW-3.

Description: The set consists of three coils—an antenna coupling coil and two interstage coupling coils. The antenna coupling coil comprises primary and secondary windings that are fixed in their coupling relation and are mounted on a thin bakelite strip which also carries the solder-lug terminals. The windings themselves consist of silk-covered copper wire which is wound on a form and then impregnated with a film of cellulose material. The form is then removed and leaves a coil of high efficiency, due to the extremely small amount of dielectric material in the immediate vicinity of the windings.

The two high-frequency transformer units are wound in this same manner but are equipped with a mechanical device which permits variation of the coupling between the primaries and the secondaries. This variation is controlled by hand and may be made with extreme accuracy.

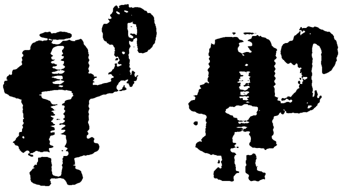
In the Loftin-White receiver the coupling adjustments need be made only once. These transformers are made with a high degree of accuracy to permit them to be simultaneously tuned by means of a tandem condenser. This means that for all practical purposes their inductance values are exactly equal.

The connection terminals of all three coil units are in the form of soldering lugs and are mounted on the bakelite strips which also serve the purpose of mountings and supports for the windings.

Usage: These three units furnish the complete coil equipment for the Loftin-White circuit that includes two stages of tuned, high-frequency amplification and a tuned detector input circuit.

Outstanding features: Electrically and mechanically efficient. Accurately made. Neat appearance. Moisture-proof windings. Adapted to the Loftin-White circuit and approved by Messrs. Loftin and White for this use.

Maker: Hammarlund Mfg. Co., Inc.



These Phone-Tip Jacks Provide Positive Contact

Name of instrument: Cord tip jacks, No. 253.

Description: The main portions of these jacks consist of a metal cylinder which is threaded on the outside and which contains a hollow plunger, a coil spring and a gripping device. A threaded bushing-bracket is also provided. To mount the jacks on a panel, a single hole approximately ⅜ inch in diameter is required. The threaded cylinder is slipped through this hole and the bushing screwed up against the panel from the back, thus holding the jack securely in position. The plunger projects from the front of the large cylinder. To make a connection with a phone tip, the tip is inserted in the hole in the plunger. Pressing in slightly on the phone tip causes the gripping device to admit the tip, and when the pressure is released the coil spring inside closes the grip on the tip. To release the tip, the plunger is pressed in. This releases the grip and permits the tip to be withdrawn.

Usage: At the connection terminals where connection is to be made by means of a wire equipped with phone tips.

Outstanding features: Positive connection. Tips will not pull out accidentally.

Maker: Herbert H. Frost, Inc.

A Device that Helps to Wire a House for Radio

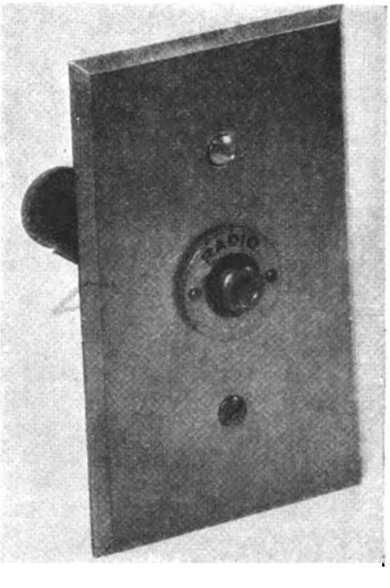
Name of instrument: Radio convenience outlet.

Description: This outlet resembles the ordinary flush-type electric wall switch except that instead of push-buttons, it has on its face only a single round hole encircled by the "radio" name-plate. Behind the satin-finished brass plate is a standard jack which is entirely inclosed to protect it from contact with the wall. All of the wiring to this outlet is carried through the walls in the same manner as the electric light wiring.

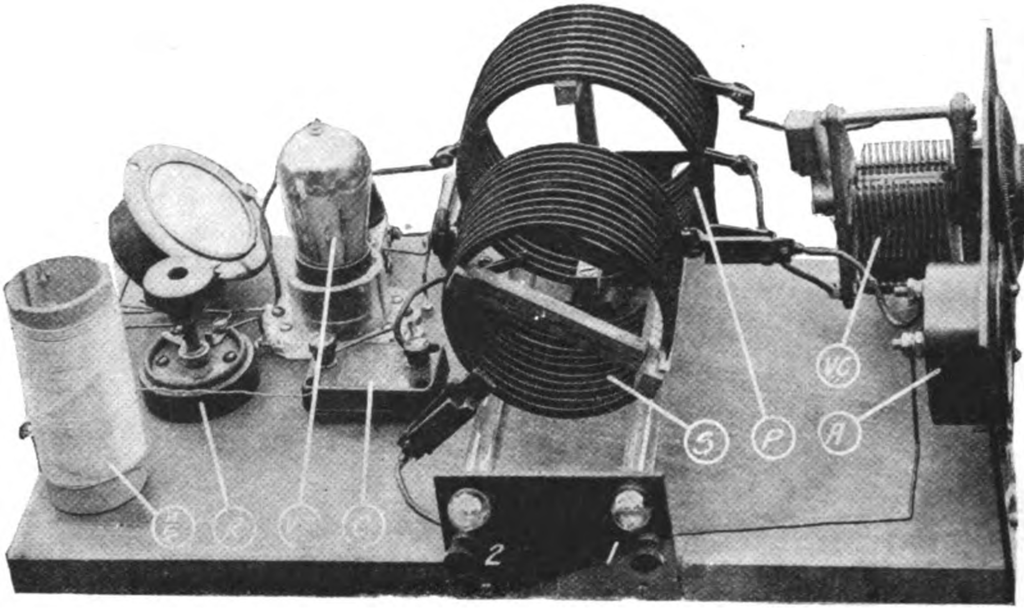
Usage: Where it is desired to have one radio receiver, but to provide facilities for plugging in reproducers at various points around the house or building. While the receiver is in operation the programs it is picking up may be reproduced in any room to which the receiver is connected by simply inserting a loudspeaker or head-phone plug in the wall jack above described.

Outstanding features: Neat in appearance. A great convenience in large homes, hospitals, hotels, etc.

Maker: Yaxley Mfg. Co.



¶ Here is an opportunity for the broadcast fan who wants to enter the field of short-wave radio to build a good short-wave transmitter—at a very small cost.



A VIEW OF THE TRANSMITTER FROM THE SIDE

Figure 1: *The view of the transmitter shows the remarkable simplicity of the hook-up for short-wave transmission. The high-frequency choke at the left and the two large coils may be constructed by the builder; the rest of the parts are easily obtainable from dealers or manufacturers.*

HOW TO BUILD

A Transmitter for Less Than $30

Anyone who has previously built and operated a receiving set can easily construct this remarkable short-wave CW transmitter, with which the author of this article has been able to work several thousand miles—using an ordinary receiving set vacuum valve and batteries.

By JAMES MONTAGNES

Cost of Parts: *Less than $30*

Here Is a List of Parts and Accessories Used in the Costruction of This Set—

S—Secondary inductance, consisting of 10 turns of edgewise copper strip on a form 3 inches in diameter;
P—Primary inductance, consisting of 9 turns of edgewise copper strip on a form 4 inches in diameter;
KL—Sending key coupling to inductance, consisting of one turn of edgewise copper strip on a form 4 inches in diameter;
VC—General Radio variable condenser, .0005 mfd.;
HFC—High-frequency choke, consisting of 60 turns of No. 22 DCC wire on a form 1½ inches in diameter;
VT—UV-201-a type valve and socket;
A—General radio high-frequency ammeter, 0-1 amp.;
V—General Radio DC voltmeter, 0-10 volts;
K—Switch;
C—Micadon fixed condenser, .001 mfd.;
GC—Sangamo fixed condenser, .001 mfd.;
GL—Bradleyleak, 1,000 to 10,000 ohms;
R—Rheostat, 20 ohms;
Wooden baseboard, 12 by 16 inches;
Bakelite panel, 5 by 12 inches;
4 Fahenstock clips;
2 binding posts;
Wire, screws, etc.

Here is a short-wave transmitter that costs less than $30, that uses a receiving vacuum valve as an oscillator, and yet has a transmitting range of several thousand miles. The set, in addition to these features, is compact enough to be used as a portable transmitter for the vacation camp. In fact, the set was built primarily as a portable for this very use, but the results were so far in advance of expectations that it is here offered to the experimenter as a good transmitter for general use.

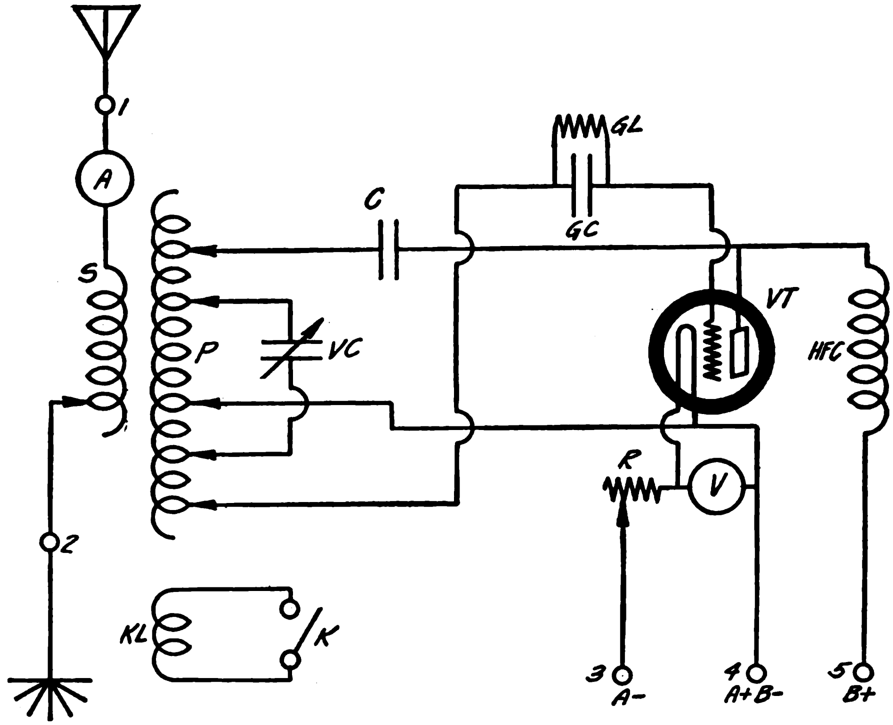
The transmitter was originally installed on an island suburb near Toronto, and was attached to a double-feed antenna tuned to forty meters. For plate supply some old "B" batteries, discarded by broadcast listeners, were obtained, with a total voltage of about 200. A UV-201 valve was used with dry cells for the filament supply. The Hartley circuit was employed, as shown in Figure 2.

Tests in daylight were conducted with Cape Cod, Mass., on one-half watt. Many Eastern and Southern stations were worked on two watts or less and HIK in Dominica, West Indies, and Quito, Ecuador, were reached with less than ten watts of power.

The transmitter, as may be seen from Figures 1 and 3, is mounted on a wooden baseboard 12 by 16 inches in size. The panel is 5 inches high. All the instruments are mounted on the baseboard and the panel with plenty of room to shift coils and adjust clips.

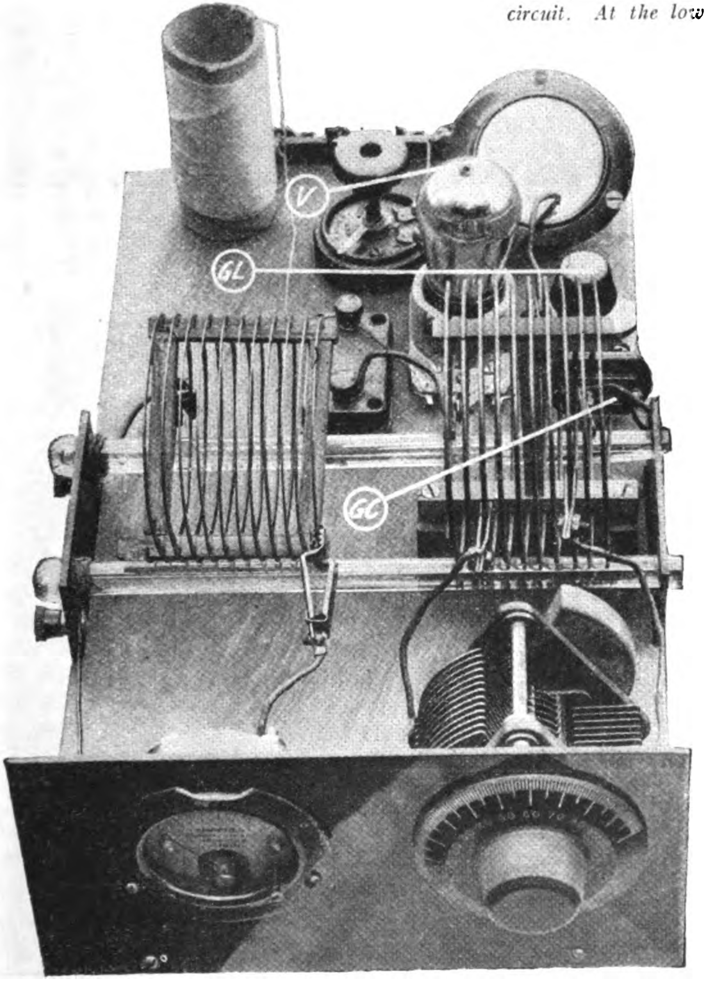
On the panel are mounted a .0005 mfd. condenser and a 0-1 high-frequency ammeter. The condenser tunes the primary inductance by means of two clips, which can be shifted to their best positions for wavelength adjustment. The antenna ammeter is connected to the antenna and secondary inductance.

The inductances are 4 and 3 inches in diameter respectively. The ones shown in the photograph are wound with edgewise-wound copper strip and supported by means of two grooved pieces of wood held in place by a crosspiece. Other coils that may be used with this set are wound with 3-16-inch brass tubing, and will hold their shape and spacing without inside supports.



THE CIRCUIT EMPLOYED IN THE TRANSMITTER

FIGURE 2: *The circuit shown above is a modification of the Hartley circuit. At the lower left of the diagram is shown the absorption circuit used for keying.*



A VIEW OF THE SET FROM THE FRONT PANEL

FIGURE 3: *The only operating controls of this transmitter are the tuning condenser on the front panel, the variable grid-leak shown at GL, and a filament rheostat.*

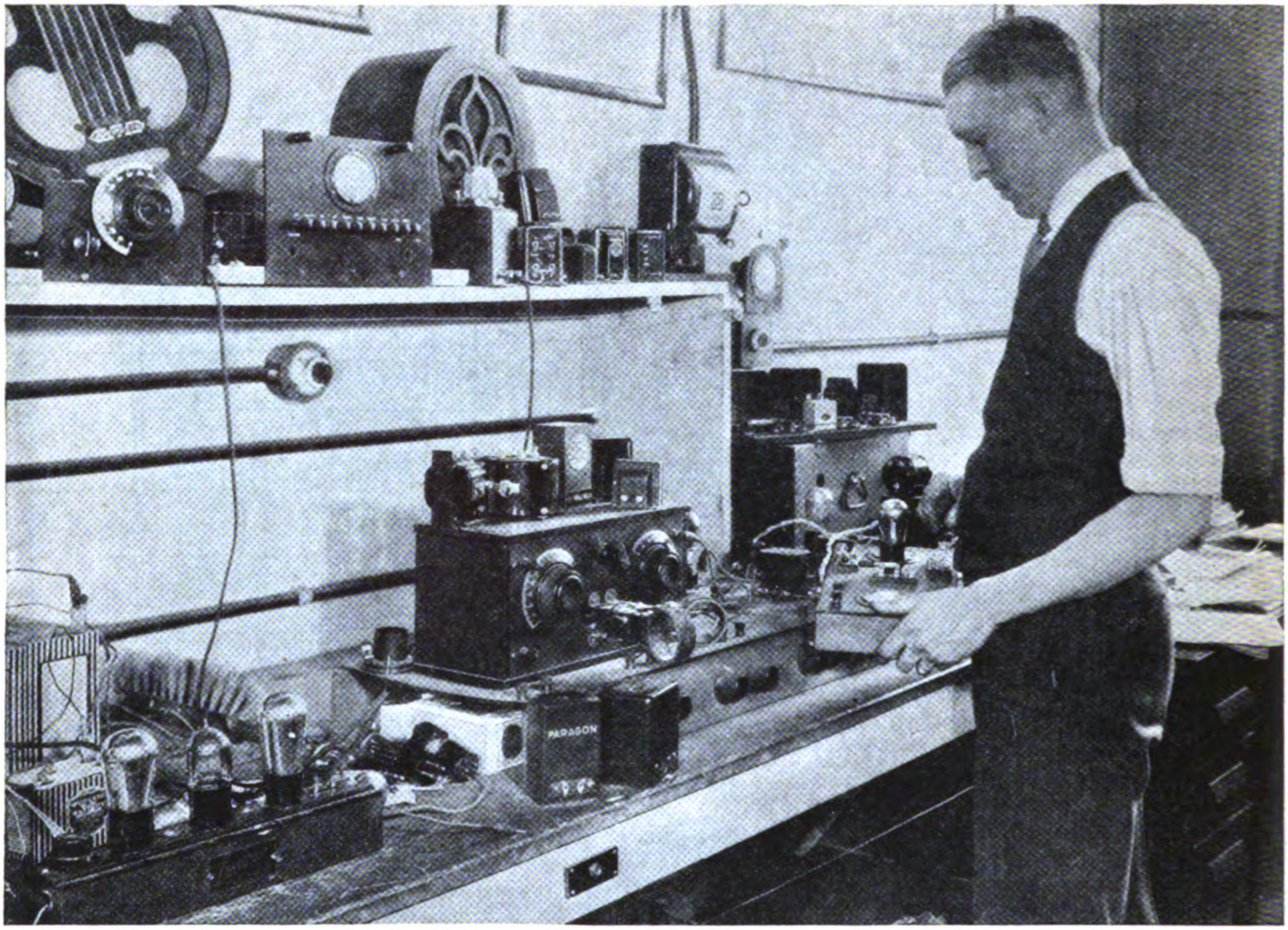
The primary coil consists of 9 turns of wire and can be used on the 40 to 80 meter band, being replaced by a 12-turn coil, 2½ inches in diameter for 20-meter work. The secondary coil, which is 3 inches in diameter and has 10 turns, is available for all three wavelengths.

The inductances are mounted on glass towel bars, which can be procured at the ten-cent store. The method of mounting is evident in the illustrations. Two binding posts can be seen on the bakelite strip in Figure 1; No. 1 is for the antenna and No. 2 for the counterpoise. The coils merely rest on the glass rods, which are spaced about 2¾ inches apart.

Immediately behind the inductances are the grid condenser and the variable grid-leak, the valve and valve socket, the plate-stopping condenser, the high-frequency choke, the rheostat and the filament voltmeter. At the back of the baseboard is a connection strip with four Fahenstock clips mounted on it.

The valve socket used is of glass, and an ordinary receiving rheostat is used for the filament supply of the vacuum valve. The plate condenser is a Micadon of .001 mfds. capacity and the grid condenser is a Sangamo of the same capacity, with a variable Bradley-

(*Continued on page 256*)



From a photograph made for POPULAR RADIO

TESTING LOW-FREQUENCY AMPLIFIERS IN THE POPULAR RADIO EXPERIMENTAL LABORATORY

This work is one of the most important items in the development of radio reception.

HOW TO SELECT

Audio Amplifiers

ARTICLE 2 of a series on the principles that underlie the amplification of low frequencies. This installment tells the proper method of comparing amplifiers, with particular reference to the transformer-coupled type.

By PROFESSOR E. L. BOWLES

IT is difficult to make a fair comparison of low-frequency amplifiers in a superficial manner. When scientific principles are involved there is often a tendency to overlook the value of experience.

For example, no device is ever developed without some actual trial before it is considered satisfactory. In fact, as time goes on, the device is usually improved as the result of experience.

In judging or comparing audio amplifiers, however, too hasty a conclusion is sometimes reached. One amplifier may give more volume than another, but the quality may be poorer. Two amplifiers may sound equally well under certain conditions, yet one may be far superior to another.

This superiority would be obvious if the comparison had been properly made. Suppose the two amplifiers had been judged by having one "on" one night and another "on" another night. It would be almost impossible to say directly that one was better than the other. Other unfair situations might be cited; for example, the two sets might reproduce programs from the same broadcast station at different times on the same evening or from different stations on the same evening at the same time.

Setting aside the possibility and probability that the transmissions of one broadcast station were better than those of the other, or that one required more amplication than the other at the receiver, one set might have reproduced a piano solo and the other a violin solo. The violin solo would be easier than the piano for the poorer amplifier to reproduce. One set might have reproduced a soprano voice, the other, a *basso-profundo* voice. The latter would lack quality in the amplifier having the lowest amplification at the lower frequencies.

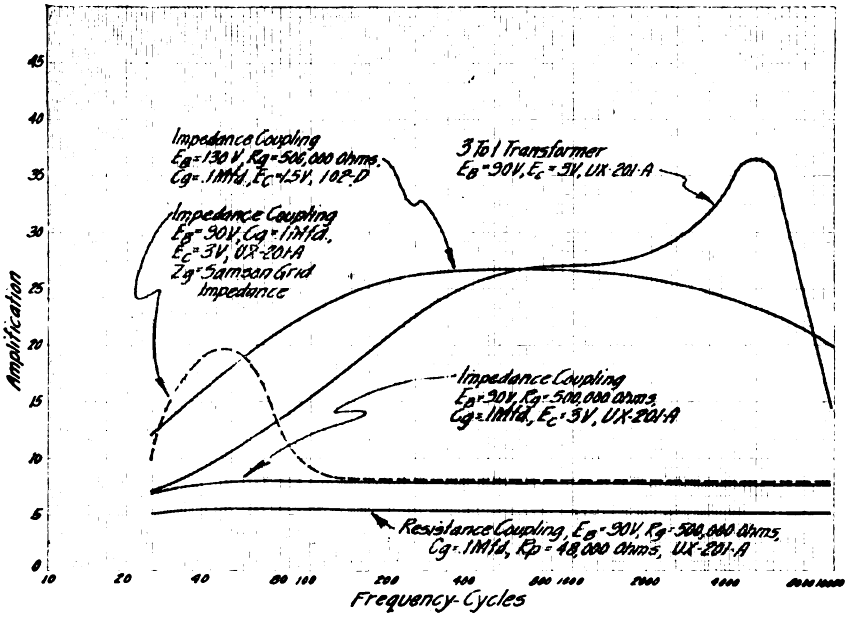
If both amplifiers had equal amplification at the higher frequencies the soprano voice would sound the same on both. Even if one of the amplifiers cut off the high notes more than the other, the chances are that this amplifier would make the bass voice sound worse than the soprano, since the low notes might sound mushy because of insufficient articulation caused by a lack of the higher audible frequencies.

Yet another trouble in making a hasty comparison would arise if one amplifier were required to reproduce passages of soft, or *pianissimo* music, and the other, passages of loud, or *fortissimo* music. With the poorer amplifier reproducing the soft music it might seem as good in performance as the better amplifier; yet had the poorer amplifier been required to reproduce the louder sounds it might have given very poor quality due to "overloading."

One good way to compare two low-frequency amplifiers is to connect them alternately to the same detector tube and its tuner. Often it is convenient to plug from the detector jack of a set to a change-over switch so that either amplifier may be switched on at will. Even in such an arrangement the "change-overs" should be made often and at points where the character or intensity of the music does not change during the operation.

These possible difficulties suggest that *the choice of an amplifier must be made with care.* One amplifier may amplify a certain range of frequencies unduly and not amplify others. In particular, a poor transformer usually amplifies excessively the frequencies in the neighborhood of 1,000 cycles per second. Thus the notes in the neighborhood of two octaves above middle "C" would be amplified an excessive amount, relatively. The same transformer probably would not amplify the notes below middle "C" at all well. Again, the transformer might not amplify properly the high notes, such as those above three octaves above middle "C."

To the person uninterested in music, the difference between a good and a bad amplifier may not be bothersome as long as he can understand the spoken word. If one were to judge a low-frequency amplifier without "trying it out" on the most varied types of sounds, the performance would be discouraging and disappointing in just the same way that it would be were one to judge an automobile he expected to buy simply by the fact that the engine ran.

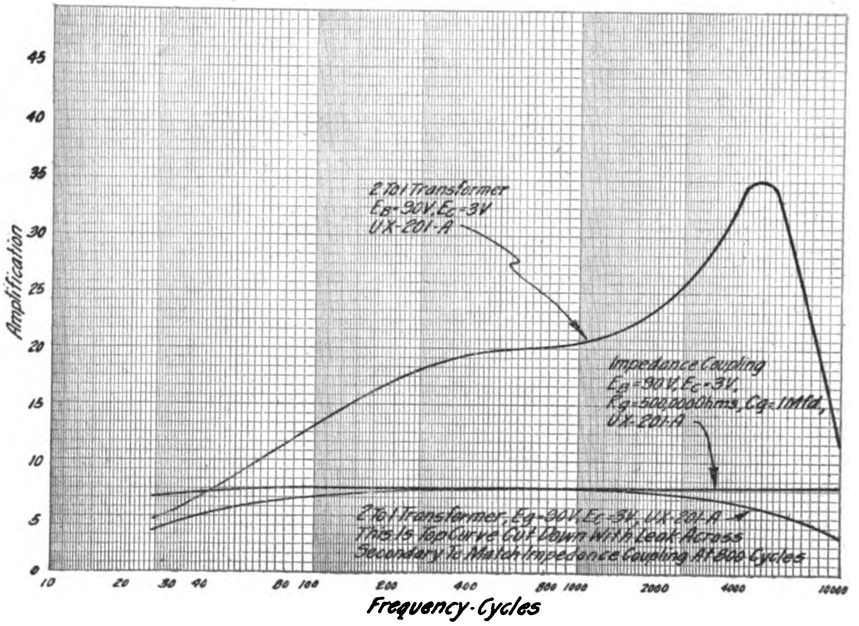


AMPLIFICATION CURVES FOR VARIOUS AMPLIFIER UNITS

FIGURE 1: *In this chart the amplification is plotted against frequency for a 3-1 transformer, for impedance coupling of various types and for resistance coupling. The curves are for a single stage using standard UX-201-a type valves.*

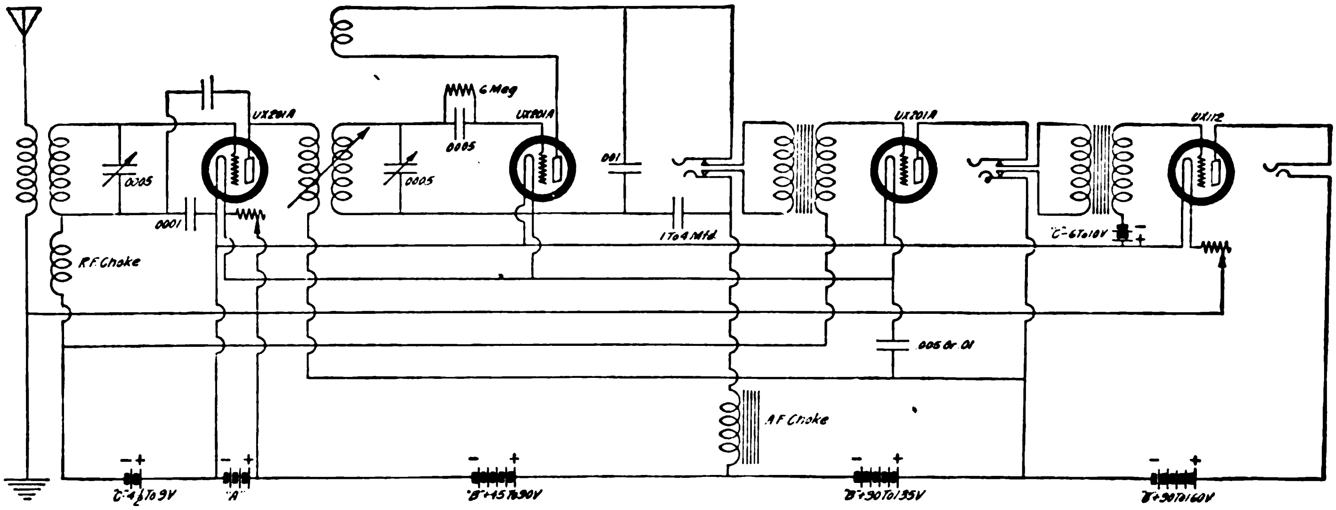
The greater the range of reproduction, the more difficult it is to design the amplifier. It is comparatively easy to design an amplifier to reproduce the average human voice so that the articulation will be fairly good. It is another thing to design an amplifier to produce the low notes of an organ, the double-bass viol, or the piano, and at the same time the high notes of the violin, with the proper amplification over all the notes in between.

The greater the volume of sound which it is desired to produce, the greater the difficulty in designing the amplifier, and the greater the care which must be taken to build such an amplifier. Also, the greater the volume, the more obvious will be the distortions which exist in the amplifier.



HOW A SHUNT RESISTANCE FLATTENS THE AMPLIFICATION CURVE

FIGURE 2: *The peaked line shows the curve for a 2-1 transformer. The lower curve line shows the results obtained with the same transformer, using a resistance shunted to the secondary, as compared with the curve obtained with a stage of impedance-coupled amplification.*



A STANDARD CIRCUIT EMPLOYING TRANSFORMER COUPLING

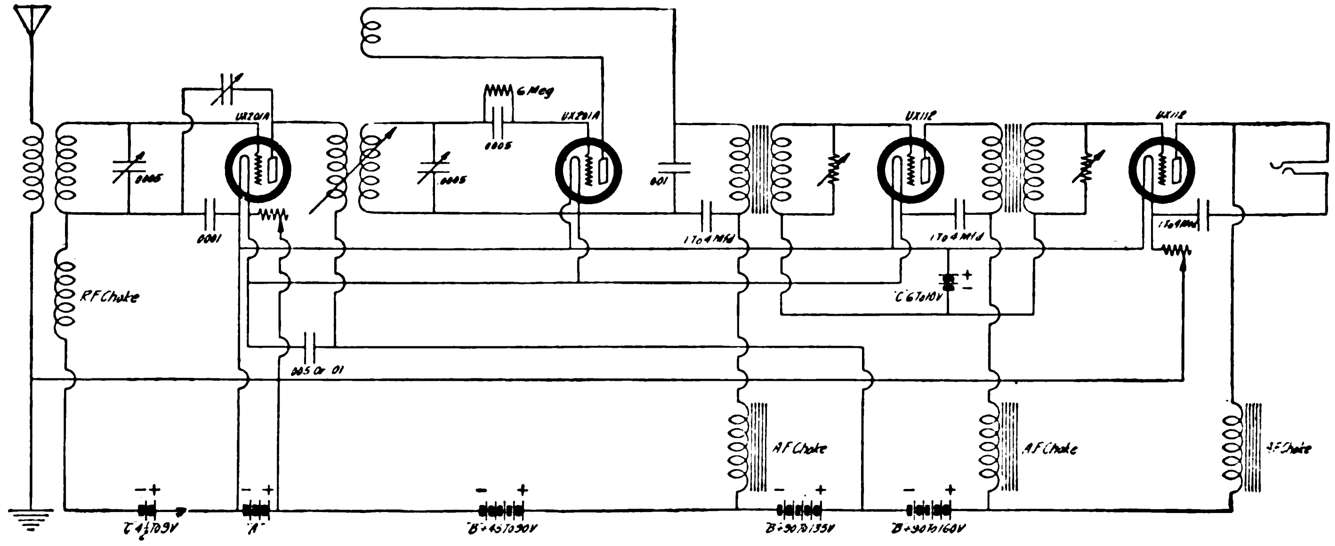
FIGURE 3: *The various methods for obtaining good quality amplification are carried out in this circuit, which employs one stage of high-frequency amplification, a regenerative detector and two stages of transformer-coupled, low-frequency amplification.*

To judge an amplifier one must not only be certain that the quality of the particular station broadcasting is recognized as excellent, but that the receiving set as a whole is properly adjusted, and that the reproducer is of a good type. It would seem ridiculous to test a good amplifier in conjunction with a reproducer if the latter were incapable of reproducing the lower notes and the higher notes which the amplifier may have been carefully designed to amplify. After all, no matter how nearly perfect an amplifier is, it cannot do itself justice if it must "feed" a poor reproducer.

An amplifier must be judged for quality at small and large volume, for permanence, and for economy. Naturally, permanence is essential; that is, the quality of the parts must be such that they will not wear out or disintegrate with time. For those interested in music, the quality must be good, and for any user the amplifier must be economical.

The measure of economy is a difficult one to fix, for some will consider it most economical to have the very best in every way. Others may be governed by "A" and "B" battery consumption, and still others by the cost of vacuum valves. In general it may be said that the smaller the tubes, the poorer the quality of reproduction. A transformer-coupled amplifier will always give better reproduction with UX-201-a type tubes than with UX-199 type tubes, and it will give even better results when UX-112 power valves are used in all amplifier stages for the same volume. To be sure there are cases where compactness, power consumption, weight, or all three, make the use of the smallest valves necessary.

The ear is a poor judge of the character, quality or intensity of a sound. Some ears are naturally more sensitive than others to low or high-frequency sounds; again, one who is musically inclined can discern a distortion or misrepresentation better than one who is not. One musically trained could in a moment discover a deficiency of lower notes or higher notes. A loud sound may be doubled in intensity (the energy doubled) and the ear may hardly detect the change. Thus it is impractical for one person to judge the quality of an



AND SOME WAYS OF BETTERING THE AMPLIFICATION

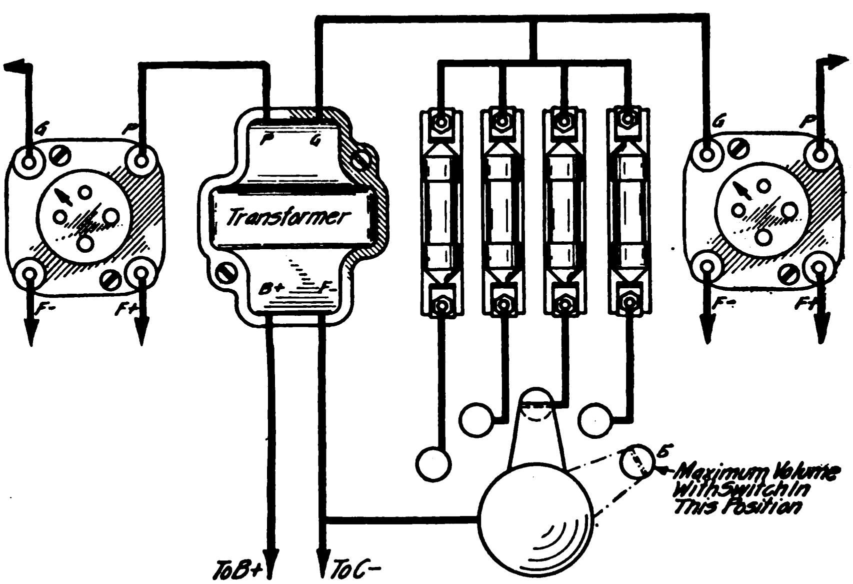
FIGURE 4: *In this circuit the addition of "C" batteries to the two low-frequency valves, which are of the UX-112 type, the use of two variable shunt resistances across the secondaries and the use of two extra low-frequency choke coils, will produce improved results in the quality of amplification obtained.*

amplifier with any degree of finality. Any aural judgment requires a study over a long period of time, for human beings see the same things and hear the same things differently from day to day.

In order to design amplifiers logically, tests on them must be made by some instrument which does not misbehave, and which is not influenced by one's temperament, as is the ear. For this reason, what are known as amplification curves are often made. They may be studied to determine how a given amplifier behaves. In this way it is possible by electrical rather than acoustic tests to determine the effects of changing certain elements of an amplifier. Effects may be measured in this way which could not be detected by the ear. Even though these effects may not be detected by the ear, when considered singly, the addition of several of them may *in total* make a decided improvement in the quality of an amplifier.

Usually voltage amplification curves are made to show how an amplifier amplifies different frequencies. Electrically, these curves represent the ratio of the signal voltage of a single frequency on the grid of a given valve in an amplifier to the voltage on the grid of the preceding valve. Figure 1 represents the effective voltage amplification as a function of frequency in several amplifier combinations, per tube and coupling unit. The frequency is carried to 10,000 cycles per second to such a scale that the changes in horizontal length along the curve represent the approximate tone changes the ear perceives. The vertical distance to the curve at any point represents to scale the voltage amplification per valve and coupling unit (that is, per stage) at that frequency.

There is not much use for a good amplifier in the receiving set if the low-frequency amplifier at the broadcast station is poor. Usually the speaking voice does not reproduce well at the lower frequencies. In order to compensate for this, it is essential that the low-frequency amplifier should amplify the lower frequencies well. In spite of this requirement, many low-frequency amplifiers are deficient in the amplification of low notes. There is a logical reason for this deficiency, *the additional cost of overcoming it.* In order to amplify the low frequencies, the development of an amplifier will require *more material,* either iron or copper or both, and *more care* in the winding of the coils entering into its construction.



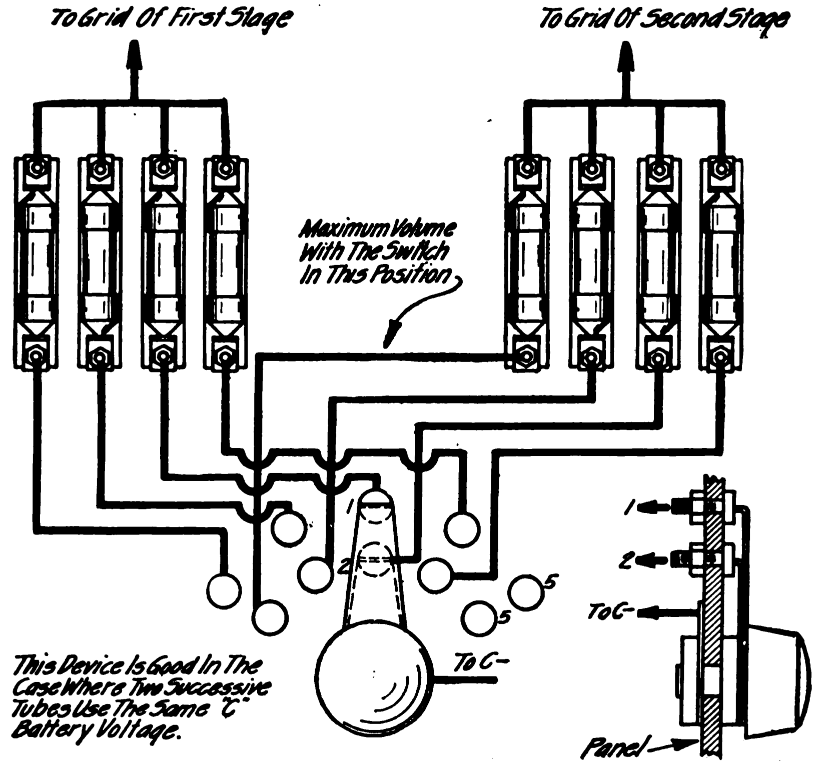
HOW RESISTORS MAY BE USED

FIGURE 5: *This drawing shows the electrical connections for a bank of four fixed resistors of different values which may be used in a transformer-coupled amplifier as a volume and quality control.*

Figure 2 illustrates how the curves of amplification compare for the Samson 2-1 transformer and the impedance amplifier. For a comparison of resistance and impedance coupling, see Figure 1. The same valves were used for all the curves. The 2-1 transformer coupling gives about twice as much voltage amplification per stage at 100 cps. as the impedance coupling, so that two stages of such transformer coupling with this particular transformer will give the same volume at this frequency as four stages of choke-coupled amplification using the same tubes. The quality *theoretically* would be better for the two stages of impedance coupled amplification.

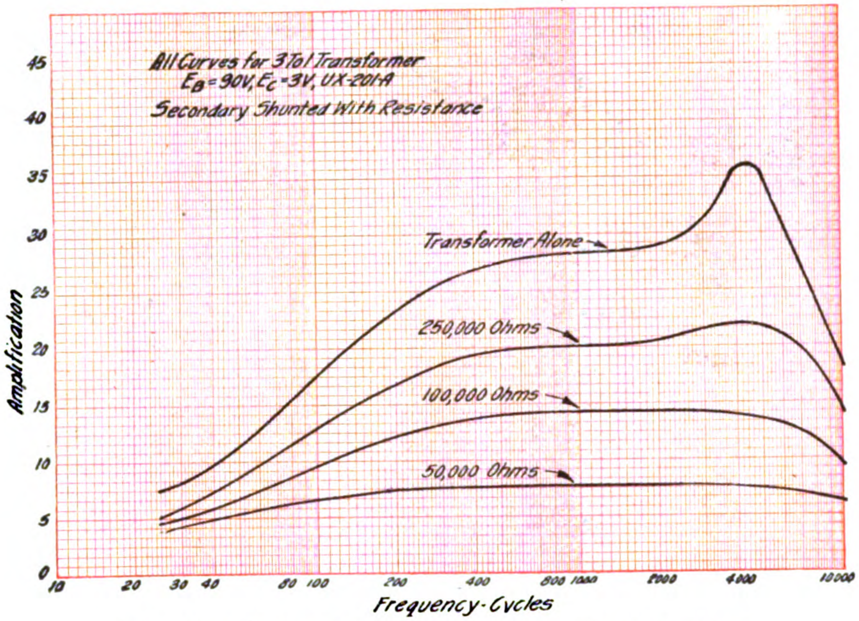
It will be noticed that although over the greater portion the transformer curve is higher in proportion, it slopes off at the lower and higher frequency ends more rapidly than does the flatter but lower impedance coupling curve.

The curves of amplification represent


To Grid Of First Stage
To Grid Of Second Stage
Maximum Volume With The Switch In This Position
1
2
5
5
To C-
This Device Is Good In The Case Where Two Successive Tubes Use The Same "C" Battery Voltage.
1
2
To C-
Panel

CONTROLLING TWO STAGES WITH A SINGLE SWITCH

FIGURE 6: *This drawing shows the connections for two sets of resistors to be used in two following stages. This allows a single switch to control both low-frequency valves at once.*



HOW SHUNT RESISTANCE AFFECTS A TRANSFORMER CURVE

FIGURE 7: *Here are a series of curves with the same transformer used alone and shunted by various sized resistors. Notice that when shunted with 50,000 ohms, the curve is practically flat, although the volume is reduced.*

the behaviour of the amplifier more accurately than the ear can determine. By judging from the curves, there is no danger of making a mistake, so far as frequency response is concerned. A snap judgment by ear will almost always result in ultimate disappointment.

It has already been pointed out that the quality of reproduction, insofar as it is affected by the receiving apparatus, depends upon the selectivity of the receiver, its proper tuning, upon the detector, the low-frequency amplifier, the reproducer, and upon its surroundings. Later the reproducer will be discussed.

The Facts About Transformer-Coupled Amplification

In order that the best results may be obtained with a transformer, the associated circuit and circuit apparatus must adapt themselves to the instrument. Figures 3 and 4 give several combinations of transformers and tubes.

The diagrams do not give any idea of the method of construction of the amplifier, but they suggest the order of the electrical arrangement. The leads should be short and direct. In the observation of this suggestion it is unnecessary to go so far as to make the wiring smack of the cubist's art. The apparatus should be arranged in an orderly manner. Often this may be done on the top of a baseboard.

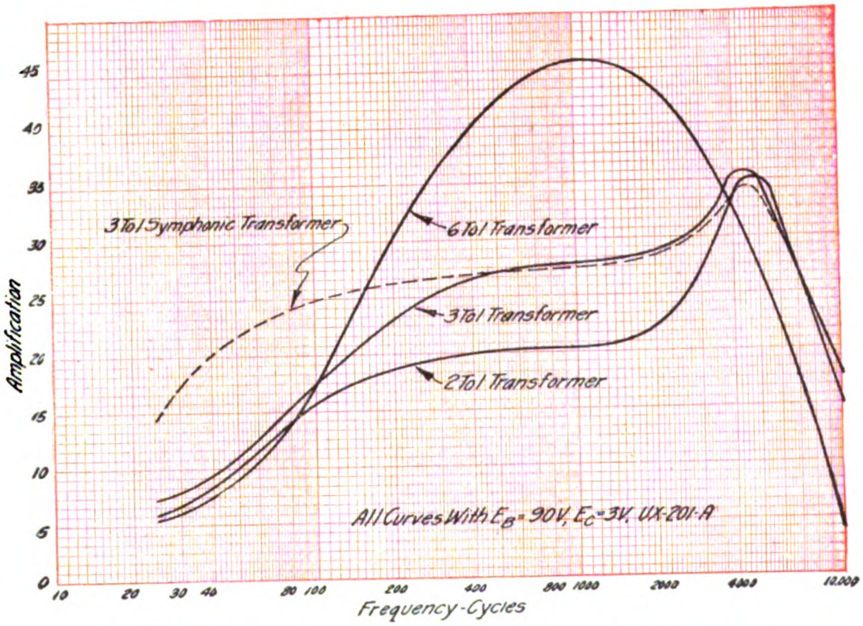
It will usually be found convenient to "bunch" the supply leads and to cable them, fanning out the cable to carry individual wires to their destination. Connections should be soldered at every point. Preferably, leads should be soldered directly to the binding post and not to a terminal held in electrical contact with the post by means of a nut.

A two-stage, transformer-coupled amplifier is shown in Figure 3. The transformers are arranged with jacks so that the reproducer may be plugged into either of the three places, the detector jack, the first stage jack, or the last stage jack. An additional refinement could be added in the form of a filament-control jack for the last stage, but this jack is sometimes the cause of trouble, owing to the complications involved. The questions of economy and practicality are for the user to settle.

The circuit is for three UX-201-a type valves or similar tubes with a UX-112 type valve in the last stage. This combination is, of course, only illustrative. Smaller valves might well be used for convenience. A larger tube such as the UX-171 type or UX-210 type may be used in the last stage. For the assurance of proper and continuous operation without the development of distortion due to the coupling through the common "B" battery (discussed in detail later) a choke is introduced into the detector "B" lead and a 1 to 4 mfd. condenser is connected from the B+ circuit of the transformer to the F+ circuit. Thus the low-frequency currents pass directly from the B+ of the transformer to the filament of the detector valve, and are restrained from passing through the "B" battery by the choke. For this reason the voice currents in the succeeding tubes which pass through the "B" battery do not affect the detector valve and therefore cannot cause squealing (oscillation) or feed-back distortion.

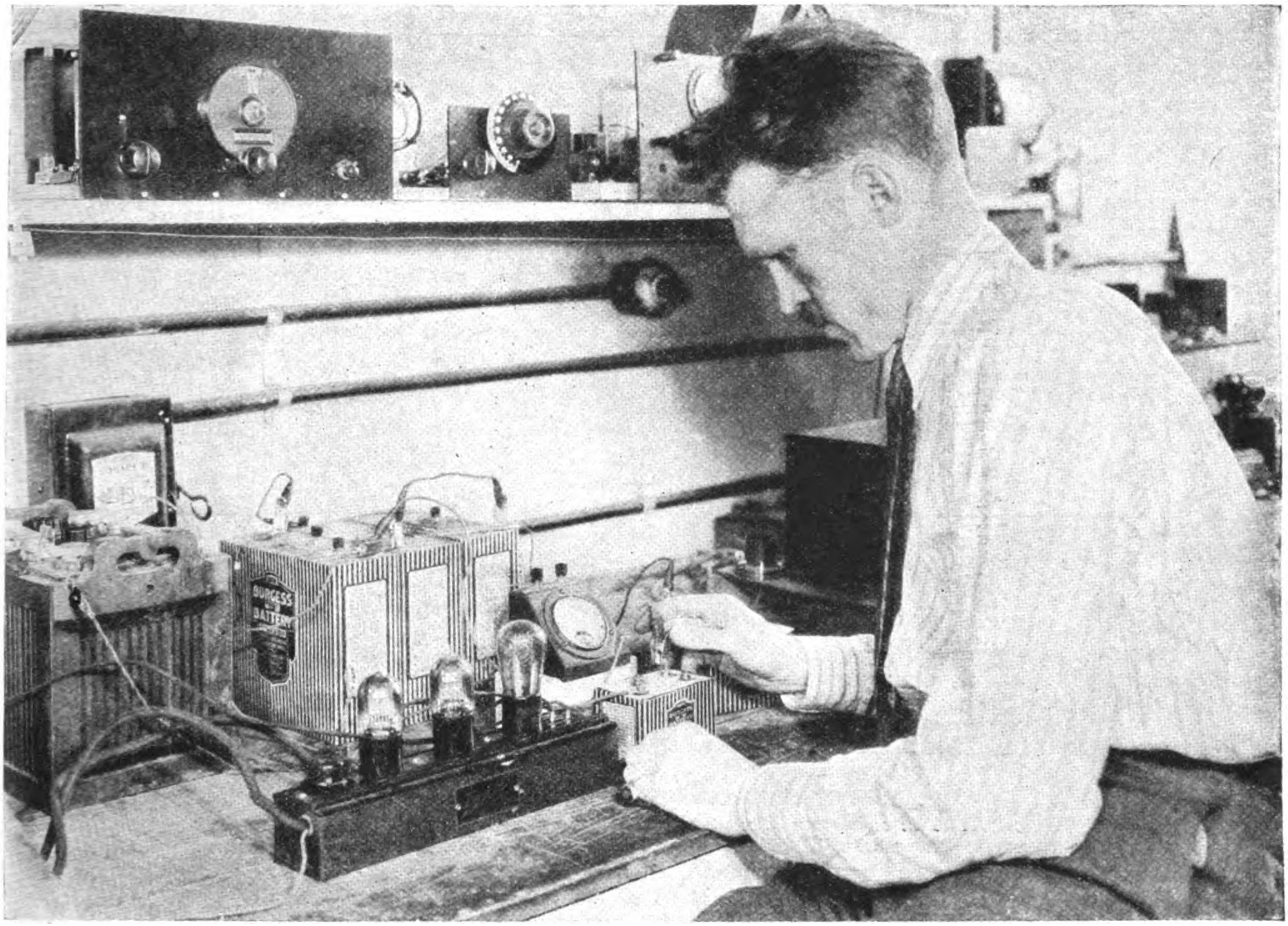
The use of a UX-112 type valve in the last stage as shown is not necessary. A UX-201-a type tube may be used instead.

(*Continued on page 254*)



HOW THE RATIO OF TRANSFORMER WINDINGS AFFECTS AMPLIFICATION

FIGURE 8: *The curves above show how transformers of different ratios vary in amplifying power over the audible range. Some transformers are many times more efficient at some frequencies than at others, thus producing distortion.*



From a photograph made for POPULAR RADIO

ADJUSTING THE "C" BATTERY

For proper operation of a receiver the use of a power tube in the last stage with high "B" voltages is necessary. The correct "C" battery voltage applied to this last tube is equally as important for efficient operation.

THE PRACTICAL USES OF

Negative Resistances

Just what is a negative resistance? What part does it play in circuit designs? What is its significance to radio? These and other questions are taken up in this interesting article.

By A. A. BLUMENFELD

THE usual conception, on the part of the amateur radio experimenter, of negative resistance is the same as that of imaginary numbers that exist in theory but which do not admit of actual representation.

However, there are a few devices which have this so-called negative-resistance characteristic. These are:

1. Arcs
2. Vacuum tubes
3. Oscillating crystals

But just what is negative resistance?

A substance is said to possess negative resistance when an increase in voltage will cause a decrease in current through it and *vice versa.*

This is most easily shown by means of a characteristic curve such as that given in Figure 6. From A to B on the curve an increase in voltage will cause an increase in current, while from B to C an increase in voltage will cause a decrease in current. From A to B on the curve the substance has a positive resistance but from B to C it has a negative resistance.

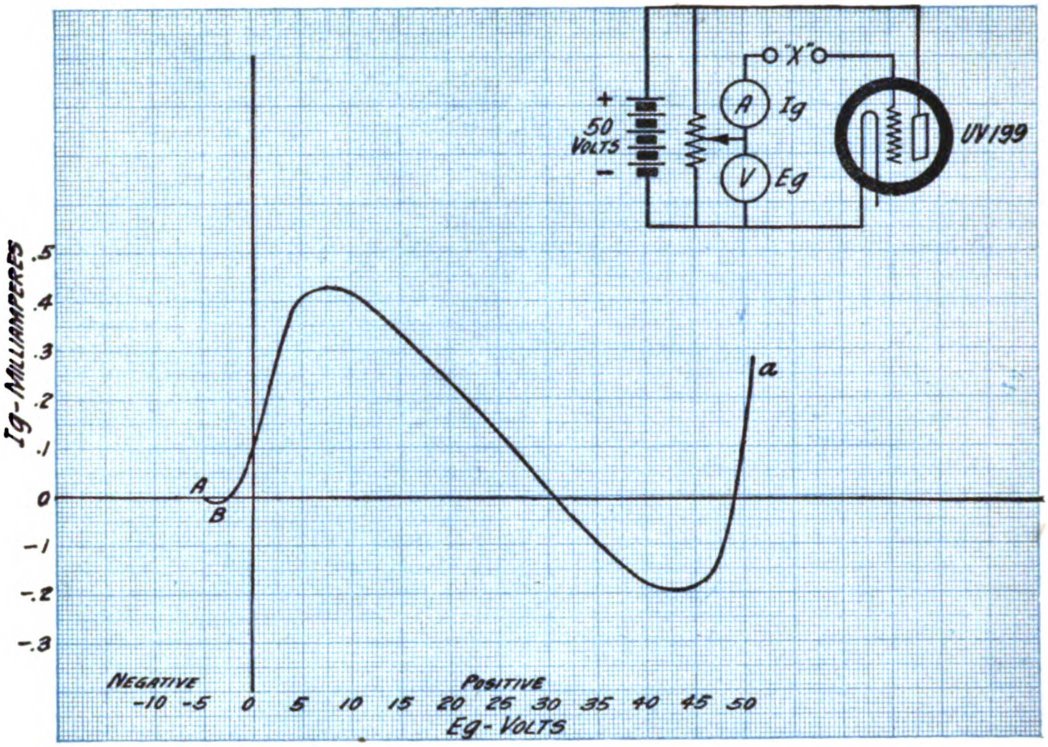
Or it may be explained mathematically by stating that when the derivative of the equation of the line is positive, the resistance is positive, and when the derivative is negative the resistance is negative. The equation is

$$4Y=4X-X^2 \text{ and } \frac{DY}{DX} = 1 - \frac{X}{2}$$

This is an exact way of saying that when the line goes up the resistance is positive and when the line goes down the resistance is negative.

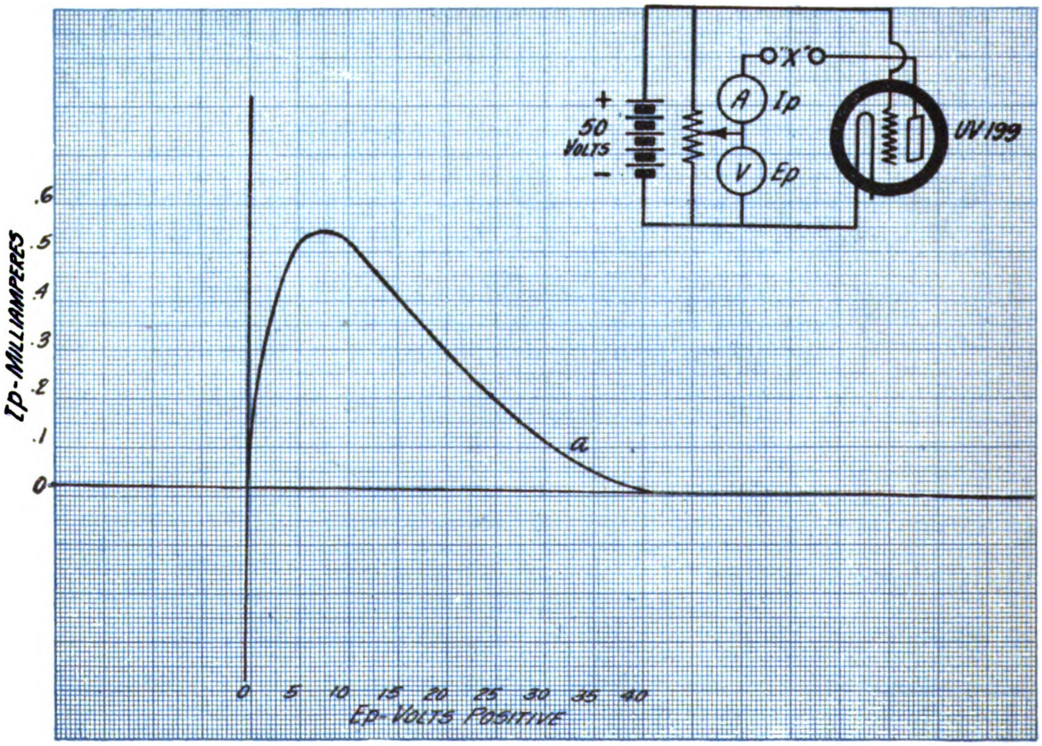
Now let us examine the characteristic curves of some negative resistance devices, taking first the oscillating arc.

The carbon arc is the most familiar and its characteristic curve is shown in Figure 7. The reason for its negative



A CURVE OF GRID CURRENT AGAINST GRID VOLTAGES

Figure 1: *This shows the peculiar change in grid current that is obtained when the voltage is made more and more positive. (The circuit for these measurements is shown in the upper right hand corner.)*



A CURVE SHOWING THE RELATION BETWEEN THE PLATE CURRENT AND PLATE VOLTAGE WITH A LARGE POSITIVE CHARGE ON THE GRID

Figure 2: *Notice how the current increases quickly from zero and then falls off at a somewhat lesser rate at about 7½ volts.*

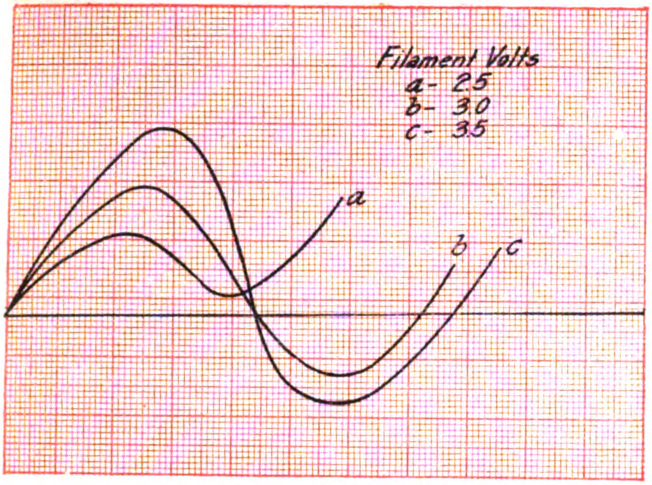


FIGURE 3: *This drawing shows the changes in the grid-current, grid-voltage curve when different filament voltages are used.*

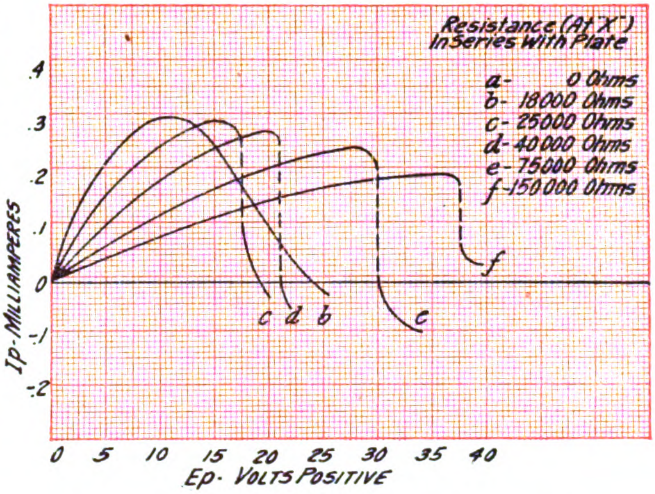


FIGURE 4: *The changes in the grid-current, grid-voltage curve as various resistances are included at "X" in the circuit in Figure 2.*

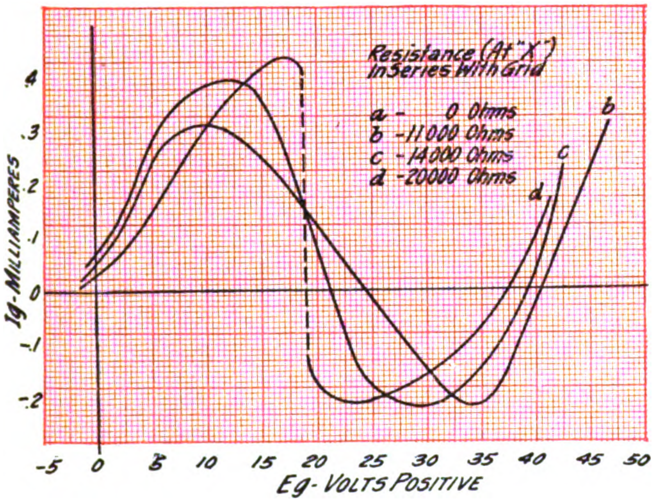


FIGURE 5: *The changes in the plate-current, plate-voltage curve when resistances are connected at "X" in the circuit in Figure 1. Notice the unstable portion of the curve, shown by the dotted line.*

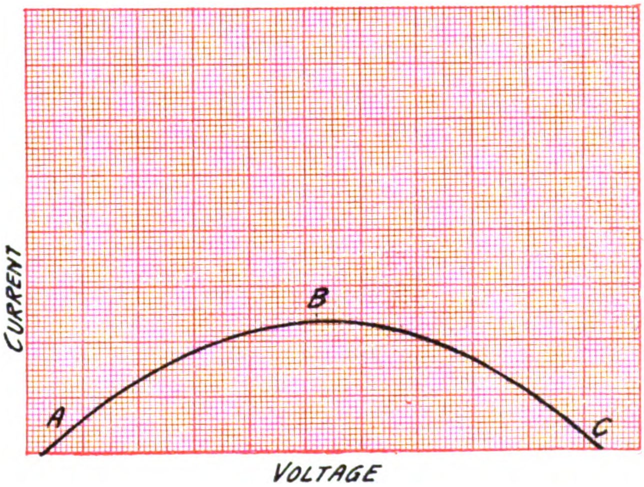


FIGURE 6: *A curve between voltage and current showing a positive resistance effect between A and B and a negative resistance effect from B to C, accompanying an increase in voltage.*

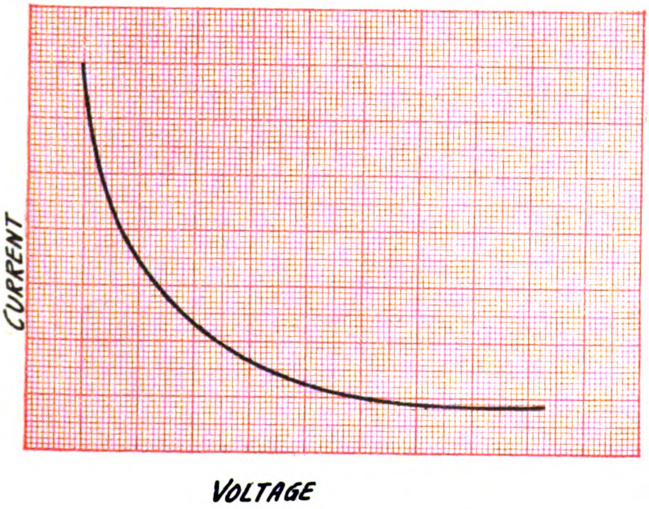


FIGURE 7: *Another curve between current and voltage showing the negative resistance effect in an arc as the current heats up the arc.*

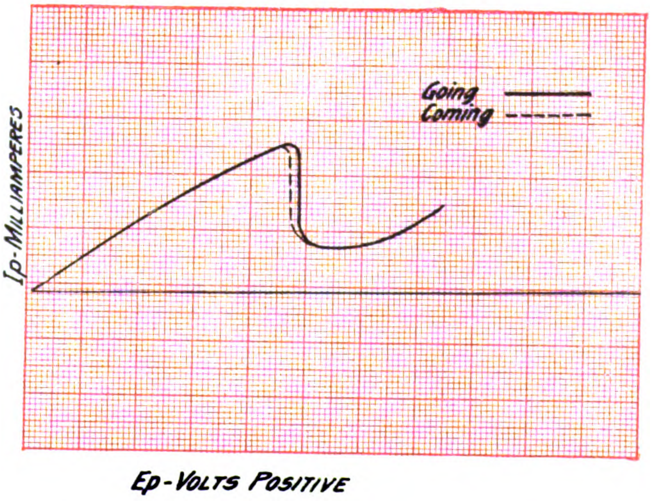


FIGURE 8: *An unstable effect in the plate-current, plate-voltage curve that affects the use of this critical setting as an amplifier.*

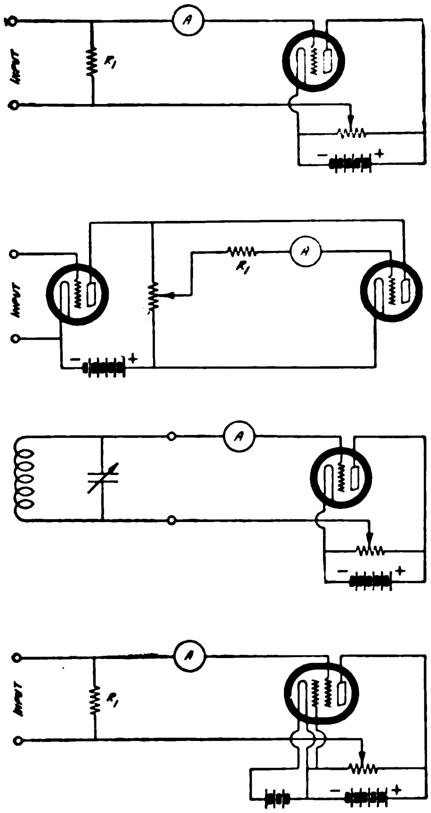


FIGURE 9: *Here are four circuits that make use of negative resistances for their operation. The last circuit employs a vacuum valve with two grids.*

resistance is the fact that an increase in voltage heats the arc, increasing its resistance and decreasing the current. Although this property makes it useful in radio (the poulsen arc), it is usually a detriment when the arc is used in industry. Should the voltage drop accidentally, the current might become excessive and do damage to the dynamos; for this reason a resistance is sometimes inserted to keep down the current.

The arc, however, is a cumbersome and unsteady piece of apparatus and is not suited to ordinary laboratory investigation. In order to understand the subject more fully then, let us consider the vacuum tube.

There are many ways in which the vacuum tube may be turned into a negative resistance device; of these the simplest is to use the *secondary-emission* effect. This effect was discovered by Hull, who used a special tube; but the ordinary thermionic tube works well in demonstrating these phenomena.

First examine the ordinary grid-voltage, grid-current curve in Figure 1. From A to B on the curve the tube is a negative resistance. This is due to ionization and is too small to experiment with. If we continue this grid-voltage, grid-current curve up to about twenty volts we find the tube again acting as a negative resistance; this time it is due to secondary emission from the grid. This secondary emission is due to the fact that when an electron hits the grid, it will knock out one, two, three and sometimes even twenty secondary electrons, depending upon the speed of the electron. The speed of the electrons depends upon the voltage on the grid; they are normally attracted to the plate, which has a higher voltage than the grid. The grid current is thereby lowered, causing the negative-resistance effect.

As the voltage on the grid is increased, these electrons are attracted back to the grid and the negative-resistance effect is lost. There is also a secondary emission from the plate, but on account of its high voltage the electrons are all diverted back to it. Here the plate is the diversion electrode. The grid can also be used as diversion electrode.

In Figure 2 is shown a plate-voltage, plate-current curve made in the same manner as the curve in Figure 1. They closely resemble each other.

There have been numerous other negative-resistance devices invented by Taggart, Turner and others. These use either a new kind of tube, or more than one ordinary tube and a complicated battery system. A diversion electrode inside the tube is usually used, as in the preceding examples, but the operation is more complicated. It is interesting to note the behavior of these characteristic curves when a positive resistance is inserted in the circuit.

Figure 5 and Figure 4 show the result of gradually adding different resistances each time and taking the characteristic curve in circuits shown in Figure 1 and Figure 2, respectively. It will be noticed that the curve gradually gets steeper and steeper; this immediately suggests its use as an amplifier in radio. Certain portions of these curves are seen to be vertical lines. This is because at a certain voltage the current simply drops without any further increase in voltage until it again reaches a stable value. The unstable portion of the curve is shown by the dotted line. It is impossible to operate the tube on this portion of the curve. When the curve has an unstable portion in it, it repeats itself, as in Figure 8. While this property is very interesting, it spoils the valve's value as an amplifier.

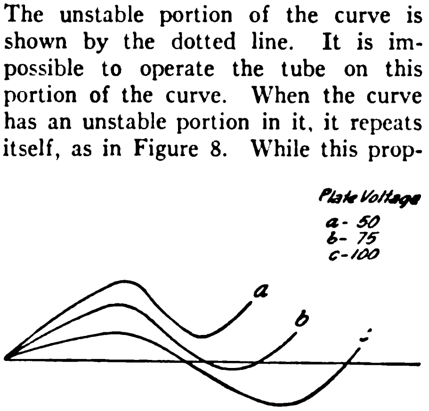


FIGURE 10: *Graph showing how various plate voltages raise or lower the current curve while the general shape remains approximately the same.*

The best condition under which to operate the tube as an amplifier is when the curve is as steep as possible without becoming unstable. Theoretically there is no limit to the amplification that may be obtained. When the positive resistance inserted is exactly equal to the negative resistance, the amplification is infinity, because the resistance of the total circuit is zero. This, however, is an unstable condition. The limit will be reached when it becomes unstable due to variations in the battery voltage. When it is used as a direct-current amplifier, the first circuit as shown in Figure 9 may be used.

If the tube is to be used to measure electrostatic voltages or to amplify radio-frequency currents, the second circuit shown in Figure 9 should be used. Phones may be included in the circuit if it is properly by-passed so that it will not oscillate at an audio frequency.

So far as oscillation is concerned, any negative resistance is capable of producing oscillations if it is set up properly. The third circuit in Figure 9 will oscillate, the frequency being determined by the inductance of the coil. The whole range from an audio to a radio frequency may be covered.

The best tube to use as a negative resistance is the UX-199. While it is not as powerful as the UX-201-a type of tube or as some other tubes, it works with less voltage; this is due to the fact that the elements are close together and the grid is close to the plate. The closer the grid is to the plate, the less voltage will be needed. Some UX-199 type valves may work on as low as 22 volts, but as a rule 45 volts should be used. When the UX-201-a type is used, it usually needs more than 45 volts.

It is interesting here to note the effect of changing the filament voltage or the "B" battery voltage. Figure 3 shows a set of curves obtained by keeping the "B" voltage constant and varying the filament voltage. It may be seen that the length of the curve is not changed, but the height varies. Figure 10 shows the effect of varying the "B" battery voltage and keeping the filament voltage constant; this shows just the opposite effect. However, as we want the curve to be as steep as possible, it will be best to adjust the tube with the highest filament voltage and lowest "B" voltage that the tube can be made to operate satisfactorily on.

A four-element tube would probably reduce battery difficulties. Here an extra grid is used to allow increased current at low voltages. The last circuit in Figure 9 shows a circuit that may be used with such a valve.

Always the *first choice* of leading manufacturers

R-200 AMPLIFYING TRANSFORMERS, $8.00

STANDARD AMPLIFYING TRANSFORMER
2:1 ratio, $5.00
3½:1 ratio, $4.00
6:1 ratio, $4.50

SPEAKER COUPLING TRANSFORMER
R-76, $6.00

OUTPUT CHOKE
R-196, $5.00

POWER PUSH PULL TRANSFORMER AND CHOKE
T-2408 Input Transformer, $8.00
T-2420 Output Choke, $8.00

AUTOFORMER IMPEDANCE
R-190, $5.00

POWER COMPACTS
(for power amplifiers)
R-171, $15.00 R-210, $20.00

130 M. A. FULL WAVE RECTIFIER
T-2098 (Transformer) $20.00
T-2099 (Double Choke) $14.00

R. C. A. A. C. TUBE SUPPLY TRANSFORMER
T-2445, $10.00

McCULLOUGH A. C. TUBE SUPPLY TRANSFORMER
T-2504, $7.50

VAN HORNE A. C. TUBE SUPPLY TRANSFORMER
T-2370, $5.00

THORDARSON
TRANSFORMERS

FEDERAL, Freed-Eisemann, Howard, Kennedy, Murad, Murdock, Pfanstiehl, Prestolite, Radiodyne, Sparton, Valley, Willard, Zenith. These outstanding trade names are representative of the highest degree of radio workmanship and performance.

No wonder, then, that they should all select Thordarson transformers as best in keeping with the high standards of performance maintained in their receivers and power units.

You, too, can benefit by the careful research of these manufacturers. Whatever your radio problem there is a Thordarson transformer ready for you at your parts dealer.

If you enjoy good musical reproduction, insist on Thordarson transformers.

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer specialists since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.

3565

MAIL THIS COUPON

Thordarson Electric Mfg. Co., Dept. G
500 W. Huron Street
Chicago, Ill.

Gentlemen:

Please send me your free booklet on audio amplification and power supply.

Name..

Street..

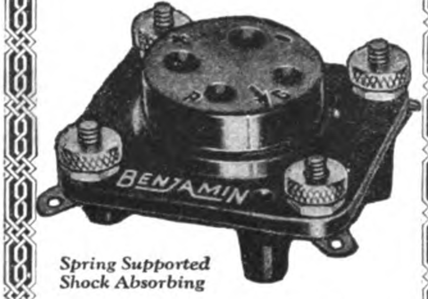
Town.......................................State....................

BENJAMIN
TRADE MARK

Cle-Ra-Tone Sockets and Brackets

are specified for the

Magnaformer
9-8 Circuit



Spring Supported
Shock Absorbing

USED the world over by set builders who know and want the best.

Stop tube noises. Anti-microphonic. The greatest contribution to the non-noisy operation of the set.

Tube "floats" on finely tempered springs. One-piece terminal to tube connection. Knurled nuts for binding post connections or handy lugs for soldering.

The choice for practically every prominent circuit for several years. Among the most recent hook-ups for which it has been specified are:

Magnaformer 9-8
Camfield Super-Selective 9
Lynch Suppressor Circuit
H.F.L. Nine-in-Line
World's Record Super 10
Strobodyne 8
Melo Heald Fourteen
St. James Super
Two-Dial Equamatic

Benjamin Shelf Bracket

An aid to simplification in set construction. Support sub-panel, with room underneath for accessories and wiring. Plain and adjustable.

At all Radio Jobbers and Dealers

Made by
Benjamin Electric Mfg. Co.
120-128 S. Sangamon St., Chicago

247 W. 17th St.
New York

448 Bryant St.
San Francisco

Manufactured in Canada by the Benjamin Electric Mfg. Co. of Canada, Ltd., Toronto, Ontario

Advance Information About the Hi-Q Receiver

(Continued from page 232)

the tuning condensers of the Hammarlund Hi-Q receiver it is possible to obtain automatically a variable coupling between the primaries and secondaries so that when the circuits are tuned to the higher wavelengths the coupling has become closer than at the lower wavelengths, resulting in practically the same uniform degree of amplification at all wavelengths within the tuning band. In other words, the amplification obtained at say 200 meters is approximately the same as that obtained at 550 meters. The illustration in Figure 5 shows this point clearly. It will be noticed that curve A shows an ordinary circuit that has a high degree of amplification at 200 meters, but an increasingly lower amplification as the longer wavelengths are approached. Curve B shows the equal amplification which is obtained by the use of the automatic coupling in the circuit of the new Hi-Q.

The Low-Frequency Amplifier

The low-frequency end of the receiver consists of two stages of high quality transformer-coupled amplification. This is a further step in the attainment of good tone reproduction. Provision is made for the use of a power valve with the correct "B" and "C" voltages in the last stage of amplification.

Volume is regulated in the high-frequency end of the receiver; this permits the control of the amount of signal energy fed to the detector input circuit. By the use of this method of volume control, overloading of the detector valve, especially in the reception of signals from powerful local stations, is guarded against, with the result that the signal emitted from the reproducer is free from distortion which usually occurs from such overloading.

The Exterior Appearance of the Hi-Q

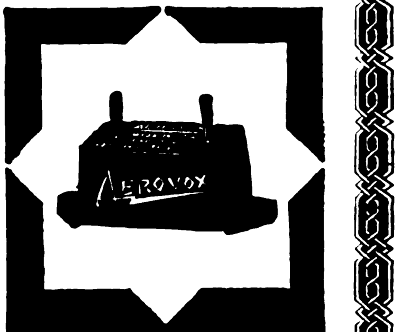
The panel appearance of the Hi-Q set is striking, in that it combines a simple beauty with an absence of complicated controls. In the center is located the double-drum control which actuates the movable plates of the condensers. This drum control is set in an escutcheon plate which lends grace and dignity to the general appearance of the receiver. Below the tuning control and to its right is the filament rheostat knob which controls the volume, while to the left is the filament switch. The connections to the reproducer are made in the rear.

It is possible in the construction of the receiver to assemble all the parts comprising the several tuned stages on the pressed steel baseplate with the box shields removed. Practically all of the wiring can be done in the same manner.

The next issue of POPULAR RADIO will contain complete and official constructional details of the new receiver.

AEROVOX CONDENSERS
are *Exclusively* specified for the

Magnaformer
9-8 Circuit



In Trouble ? ?

[illegible]

AEROVOX

Quali-Tone

DE LUXE

Exclusively
Specified for
the
MAGNAFORMER
9-8 Circuit

Also recommended for use with 9 In Line—World Record Supers—Melo Heald—Victoreen—St. James—Popular Mechanics' Economy Nine—and many others.

Holds
Two World
RECORDS
For DX
Reception

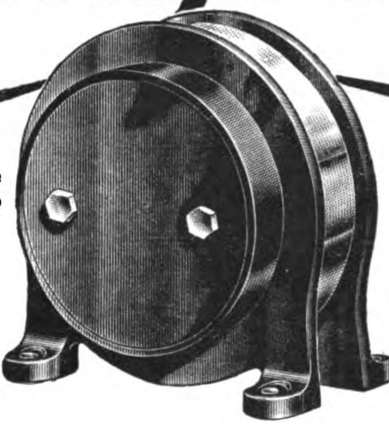
ENJOY your set more with a DE LUXE or QUALI-TONE LOOP. They greatly improve the performance of any loop receiver using .0005 condensers. Far superior to all other antenna for SELECTIVITY—TONE—APPEARANCE. Now you can separate these troublesome stations and bring in DX programs with ease.

The De luxe $12.50
The Quali-tone 10.00

JOBBERS write for discounts DEALERS
Send for circulars

DURO METAL PRODUCTS CO.
2655 N. Kildare Avenue Chicago

Magnaformer



Price
$8.50

Magna—The dictionary definition of "magna" (Latin) is "great"; the definition of "former" is "creator". Thus, we have the **Great Creator**, truly a name emblematic of the astonishing accomplishments of the Magnaformer.

Two Years Ahead in Design

At the Radio Trade Show in Chicago, the announcement of the Magnaformer was one of the few startlingly new ideas in radio development. We know from actual observation that the Magnaformer is two years ahead in design, for it incorporates advanced and evolutionary ideas throughout. It is distinctly different, with its self-shielding, matched units, double amplification for each R. F. stage and excellent laboratory construction. It is a fresh idea—the very heart of the new and better receiver in which its remarkable qualities are given full range. Coming, as it does, when the air has been cleared by the new rulings of the federal radio commission, it makes it possible to secure exceptional results, accomplishments heretofore unknown to radio fans.

The Great Creator of True Tone Quality

The Magnaformer 9-8 circuit—Commander-in-Chief of the air—now being featured in complete constructional articles by G. M. Best in Radio, by L. M. Cockaday in Popular Radio, Kenneth G. Ormiston in "Radio Doings" and by the Chief Technical Editor in Citizens Radio Call Book and in numerous other magazines and newspapers—is two years ahead of the field in new, True-Tone Quality creating improvements. A Magnaformer 9-8 set possesses a fidelity and purity of tone that is actually marvelous. Mere words cannot define nor describe it. Only the ear itself can understand and appreciate its full, clear, natural sweetness. Women, musicians and experts—especially—are enthusiastic in their praise of the tone quality of the Magnaformer 9-8, for it represents the dawn of a new and far greater satisfaction in radio reception.

Advanced Electrical Design—Absolute Mechanical Precision

The "soul" of any radio set is its tone quality. "For what shall it profit a man if he gain the whole world and lose his own soul." Likewise—what do we gain if our radio sets have the finest cabinets, the best speakers, batteries, tubes, aerials, etc., etc.—if they have no "soul"—if they lack True Tone Quality?

The most magnificent performance any radio will ever give is faithfully to reproduce the output of the broadcasting stations. This the Magnaformer 9-8 does very nearly to perfection. The difference between the tone quality of the Magnaformer 9-8 and ordinary radio sets—no matter how good looking or expensive—is the difference between the tone quality of an ordinary piano and a Steinway—the difference between the tone quality of the voice of a cheap vaudeville singer and the voice of a Caruso or a McCormack—the difference between the tone of the old style phonograph and the new Orthophonic Victrola.

The tone of a cheap piano is disappointing to those who have had the pleasure of listening to a Steinway. The tone of an ordinary radio set is equally unsatisfactory to the ears of all those who have ever heard the beautifully natural tones pour forth from a Magnaformer 9-8. Build a Magnaformer 9-8 for yourself or have one built for you and you will experience the supreme satisfaction of possessing the very choicest and most accurate reproducer of radio broadcasting possible to construct.

Fidelity in Tone Reproduction

The thunderous tones of a mighty organ—the full, rich, resonant tones of the opera singer—the soft, appealing tones of the violin—the plaintive tones of the flute or piccolo—the perfect, individual tones of each musical instrument in a 100-piece orchestra—every iota of tone shading of the entire range of the human voice, from the lowest bass to the highest soprano and from the softest whisper or Pianissimo to the most massive Double Forte—all of these are FAITHFULLY reproduced by the Magnaformer 9-8. So clearly, distinctly and truly is every minute detail of the most elaborate and varied broadcast program reproduced by the Magnaformer 9-8 that you must marvel at its degree of perfection.

The Secret of Its Success

The advanced electrical design and absolute mechanical precision of MAGNAFORMER Long Wave Radio Frequency Transformers accounts for the marvelously true tone quality of the Magnaformer 9-8 receiver. These R. F. Transformers are strictly a laboratory product—the result of a great many experiments and tests extending over a long period of time. The object of these tests was to develop and perfect a very superior precision instrument that could be duplicated by the thousands—each duplicate having EXACTLY the same characteristics as the master coil itself.

These tests and experiments have eventually, after a long period of time, proved highly SUCCESSFUL. Each Magnaformer is to all intents and purposes EXACTLY like every other Magnaformer. Only by the employment of elaborate Laboratory apparatus can even the expert technician discover a difference. It is this EXACT matching—and building them so carefully and mechanically perfect that they stay EXACTLY MATCHED under all sorts of conditions that insures the exclusive degree of True-Tone Quality that the Magnaformer 9-8 possesses.

Super-Powerful Receiver

The Magnaformer 9-8, being an extremely powerful multi-tube receiver, the incoming Radio High Frequency signal must necessarily pass through several amplifying stages before it reaches the detector. If each and every Long Wave R. F. Transformer that is connected to each and every tube in each and every stage of the R. F. section of the receiver is not to all intents and purposes EXACTLY like each and every other Transformer in the set in electrical characteristics, it is absolutely impossible to secure True-Tone Quality.

Every Magnaformer is peaked to a certain definite wave length. This peaking is all done in the laboratory by thoroughly trained experts. Each and every Magnaformer can pass ONLY the same identical length of wave. Therefore, the full and complete wave-band with 100% of its vital, quality-producing, harmonic-carrying side-bands, is positively and easily passed through all of the Radio Frequency amplifying stages. This extraordinary performance of Magnaformers naturally results in as nearly true tone quality as is possible to achieve. And in no other manner can True-Tone Quality be achieved.

After Magnaformers are precisely peaked—every one alike—they are permanently sealed so that there can be not the slightest possibility of any change of wavelength at which they are peaked. They cannot be effected by moisture, dust, change of climate, age or jarring. They are so carefully and rigidly constructed mechanically as to preclude any possibility of change of electrical characteristics.

Selectivity, Volume, D-X

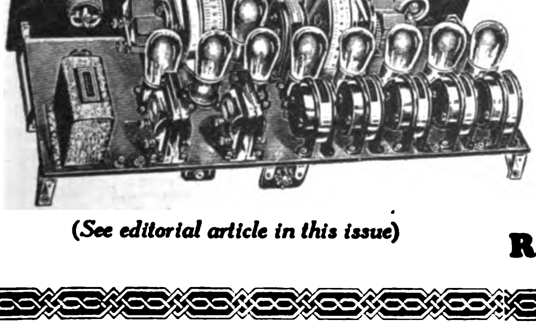
Naturally, the Magnaformer 9-8, besides possessing the very highest tone quality, also possesses in equally high degree the other three qualities necessary in a first-class receiver—selectivity, volume and distance-getting ability.

On account of the precise exactness of the electrical factors of Magnaformers, the set is exceptionally selective, although not critically so. Stations are easily tuned in or out at will without having to be located by a micrometer adjustment of the dials as is the case with sets whose long wave transformers are not EXACT.

Magnaformers were also designed to give the greatest possible amplification per stage. You will find that Magnaformers give nearly double amplification per stage. It is seldom ever necessary to use the entire 9 tubes—8 tubes give a world of volume even on distant stations. You will use 9 tubes only on very distant or very weak signals. The switching from eight to nine tubes and from nine to eight tubes is done instantly by means of a convenient little switch located on the front panel.

The precise matching of the Magnaformer Transformers and their great amplifying power naturally makes the Magnaformer 9-8 hypersensitive to even very weak signals that would be absolutely impossible of reception on ordinary sets. Probably no other type of set can log as many distant stations of an evening as can easily be brought in on a Magnaformer 9-8. It certainly hasn't a peer in great distance-getting ability.

Everyone now has the opportunity to enjoy the Magnaformer's exceptional performance. You can be one of the very first to build it and to enjoy its superb tone quality. After you once hear it you will appreciate why it is called Magnaformer—The Great Creator of True Tone Quality. You are privileged to secure all the facts. You are more than welcome to them. If you will merely mail the coupon below we will gladly send you complete Magnaformer 9-8 literature. Write today—surely.



(See editorial article in this issue)

Radiart Laboratories Co., 19 S. La Salle, Dept. 47, Chicago.

Dear Sirs: Please send me your complimentary descriptive literature on the Magnaformer 9-8 receiver containing facts regarding its remarkable performance and true tone quality.

Your Name..

Address ....

City ....

Radiart Laboratories Co. **19 S. LaSalle St., Dept. 47**
CHICAGO, ILLINOIS

FROST-RADIO
EXCLUSIVELY SPECIFIED FOR THE
Magnaformer
9-8

The Frost-Radio parts listed below are exclusively specified for the Magnaformer 9-8 Receiver. These are the NEW Frost De Luxe items, obtainable at your dealer's. Be sure to use Frost parts when you build this great receiver.

The New De Luxe Frost Parts are of the highest quality known to radio. Rheostats and Potentiometers have new Bakelite Resistance Strip, flexible and distortionless under all working temperature conditions. Hand buffed nickel plated metal parts; engraved bakelite pointer knobs.

FROST-RADIO

FROST-RADIO PARTS FOR THE MAGNAFORMER

For your new Magnaformer you will need the following Frost parts:

1 No. S-1810 De Luxe Bakelite Combination Rheostat and Battery Switch, 10 ohm.
1 No. 1824 De Luxe Bakelite Potentiometer, 400 ohm.
1 No. 1810 De Luxe Bakelite Rheostat.
1 No. 1830 De Luxe Bakelite Rheostat, 30 ohm.
4 No. 253 Cord Tip Jacks.

NEW!
FROST-RADIO GEM RHEOSTAT

It's a good little rheostat. Precision workmanship throughout, with the NEW Frost flexible Bakelite resistance strip foundation. Diameter: 1½ in. Depth 11/32 in.

FROST-RADIO

Frost Gem Rheostats are supplied in 7 resistances, from 3 to 30 ohms, and may be had with battery switch if desired. Off position is positive, and contact at all times is self-cleaning. List: Without switch, 75c; with switch, $1. You will like the Gem Rheostat the moment you set eyes on it.

FROST-RADIO

FROST-RADIO FIXED RESISTANCES

FROST-RADIO

Wound on flexible Bakelite with staked terminals and resistance wire of ample capacity. Made in a wide variety of resistances. List, up to 50 ohms, 15c. 100 to 1000 ohms, 25c.

HERBERT H. FROST, Inc.
Main Offices and Factory
ELKHART, IND.

Chicago
New York
Boston
Philadelphia
Los Angeles
Washington, D. C.
Pittsburgh
New Orleans
St. Paul
Buenos Aires

How to Select Audio Amplifiers

(*Continued from page 246*)

It will give practically the same results *up to a certain volume of sound output from the reproducer.*

Good results will be obtained by using UX-112 type valves in both the third and fourth sockets of Figure 3; of course, the "B" and "C" battery values must be properly chosen. The use of two of these power tubes in a two-stage transformer-coupled amplifier results in an improvement in reproduction over the use of UX-201-a type valves by bringing in the low notes more intensely. Again, for even greater output a UX-171 type tube may be used in the last stage with appropriate plate and grid voltages.

Figure 4 covers the same general circuit as Figure 3, with the exception that there are no interstage jacks. This simplification has at least two things to recommend it. In the first place, the elimination of the jacks with moving contacts removes the possibility of open circuits or loose connections; and secondly, the most important, the volume is controlled with a graduation that is uniform and not abrupt as in the case of plugging out of one stage into another.

The volume is controlled in what the author believes is the most logical and correct way: by means of variable resistors connected across the secondaries of the transformers. These resistors may be special devices for the purpose with a uniformly variable resistance controlled individually or in tandem, or they may be made up of a series of fixed resistors as in Figure 5. The use of a two-contact, single-blade, rotary switch arranged as illustrated in Figure 6, makes it possible to regulate both transformers simultaneously. The variation of the resistance values of these resistors across the secondaries of each transformer simultaneously is a simple and proper thing to do in order to obtain the best quality.

Figure 7 brings out the importance of using resistors across the transformer secondaries to regulate volume. The curve of highest, overall amplification represents a 3 to 1 transformer. The successive curves below represent the effects of the different sized resistors. The lower the resistance used, the flatter or the more uniform the amplification as a function of frequency. The maximum value of the resistance of such a control resistor should preferably be about 0.75 megohm, capable of going down to about 0.005 megohm or 5,000 ohms.

Some variable resistors, made to go low enough in value, may not be capable of going high enough. They are very useful for control where the incoming station is near by, but their use cuts down the maximum obtainable amplification under other circumstances. This can be overcome by providing a means of disconnecting them or by adding an extra stage of amplification.

The arrangements of Figures 5 and 6 have the advantages that when the switch arms are on points marked "5" there is no resistance across the secondaries of the transformers.

The advantage of this means of volume control lies in the fact that as less and less resistance is shunted across the secondaries of the transformers, with the consequent decrease in volume, the quality improves, since the amplification of frequencies in the concert range becomes more uniform. This is brought out by the curves of Figure 7. By this resistance methods of control, the more powerful stations will be brought *down to the proper signal strength,* with improved quality.

Most other methods of control injure the quality in many cases, as we shall see later. An exception to this lies in the receiving circuit shown in Figures 3 and 4, where, if a variable primary coupling is used in the high-frequency transformer between the first two amplifying vacuum valves, the volume may be controlled by varying this coupling, without affecting the quality.

In order to realize the full advantage of the resistor method of volume control, it is necessary that the resistors be placed across the secondaries of all transformers, and that they be controlled to give approximately the same resistance across every secondary.

Where it is desirable for some good reason to control the volume of a transformer by connecting a variable resistor across the primary of the transformer, the operating characteristic of the amplifier will be practically the same as if the resistor were connected across the secondary terminals as in Figure 5. However, to obtain results corresponding to Figure 5 by means of a variable resistor across the primary, it would be necessary to use resistance values about one-twentieth as large as the values required across the secondary.

From the amplification curve for the special symphonic transformer, in Figure 8, it is evident that a two-stage transformer-coupled amplifier, built as outlined and with these transformers in either Figures 3 or 4, will give excellent results that will please even the super-critical. Here again a shunt resistor control of volume is suggested.

The importance of careful consideration of amplifier characteristics cannot be overlooked in the choice of a low-frequency amplifier if the best tone quality is desired. Not only must the amplification be sufficiently uniform at all important frequencies, but power considerations must be taken into account to eliminate overloading.

TRUE MUSICAL RECEPTION

Audio Frequency Transformers

HIGH AMPLIFICATION ratio with flat curve . . . High primary inductance maintained under normal operating conditions . . . Low leakage reactance resulting in uniform amplification at high frequencies . . . Primary winding of ample cross section to withstand continuously, plate currents resulting from all usual operating conditions . . . No compound or fibrous material used in construction, therefore low self and mutual capacity with durability and long life . . . Core of specially tested material of ample cross section . . . Primary shunted with built in condenser of correct capacity . . . Every transformer subjected to ten tests to insure uniformity of product . . . Tested to one thousand volts throughout.

TYPE AF-4 $8.50
Ratio . . . . 3½ to 1
Dimensions 2¼" x 3" x 3¼"
Weight . . . 1 lb. 8 oz.

TYPE AF-3 $12.00
Ratio . . . 3½ to 1
Dimensions 2¼" x 3" x 3¼"
Weight . . 1 lb 14 oz.

FERRANTI A. F. 4 TRANSFORMERS

Exclusively specified for the

Magnaformer 9-8 Circuit

TYPE OP-1 $10.00
Ratio . . . . 1 to 1
Dimensions 2¾" x 3" x 3¾"
Weight . . 2 lb. 10 oz.

Output Transformers

High efficiency with low leakage inductance and self capacity improves loud speaker results . . . Insulates the loud speaker, preventing accidental contact with high plate voltages required with power tubes . . . Danger of burning out the delicate windings of the loud speaker and of demagnetizing its magnets is eliminated . . . Tested to 1000 volts throughout, therefore . . . Safe for use with highest plate voltages used in high grade radio receiving sets . . . Connect primary to Output of set, secondary to loud speaker.

FERRANTI *Ltd.*
Hollinwood England

FERRANTI *Inc.*
130 West 42nd Street, New York, N.Y.
(Member Radio Manufacturers' Association)

FERRANTI ELECTRIC *Ltd.*
Toronto, Ontario, Canada

Illuminated
15 Inches of Dial Space
Renewable Dial Strips
Right or Left Hand Mountings

REMLER *Drum* DIAL

Exclusively Specified for the

Magnaformer 9.8 Circuit

Any circuit—no matter how good—can be ruined by inferior parts. That is why circuit designers search the entire radio parts field for instruments of outstanding excellence. That is why the Magnaformer designers choose the Remler Drum Dial over all competing parts. . . . Yet it meets the requirements of all standard and gang condensers. Built up to rigid Remler standards and then priced on the basis of volume output.

Write for two-color illustrated catalog folder.

Price $4.50

REMLER

Division of
GRAY & DANIELSON MANUFACTURING COMPANY
260 First Street, San Francisco
Chicago Eastern Warehouse: Elkhart, Indiana New York

ALL Magnaformer PARTS IN STOCK

We can furnish you with complete kit of parts for the famous MAGNAFORMER 9-8 Receiver—just as described in construction article in this issue.

WHOLESALE DISTRIBUTORS

We are wholesale distributors for the New Tyrman "10" Receiver, the 9 in Line, Worlds Record Super and all other popular kits.

FREE
New 1928 Catalog

Write today for our new 1928 Catalog. It's free to Dealers and Professional Set Builders. Contains list of parts for the above mentioned kits and for all other popular hook-ups. This new catalog includes the newest parts and complete lines produced by Silver-Marshall, Karas, Carter, Aero, Daven, and describes everything worth while in radio.

SERVICE

We can deliver any kit or part same day order is received. Complete stock on hand, ready for immediate shipment. No delays. Write today for new catalog and revised list of prices.

Prompt Service—No Substitutes

MILLER-WELLES CO.
18A—W. Kinzie St.
Chicago

Are You Planning to Use the New Alternating Current Tubes?

Those who are planning to build new A. C. receivers or convert their old receivers by the use of A. C. tubes will do well to follow the activities of the POPULAR RADIO Laboratory. Our Laboratory experts are now planning and building full A. C. receivers of every type and this work will begin with this issue of POPULAR RADIO and will be described in full detail in the forthcoming issues. These new numbers of POPULAR RADIO will make radio history and those who are not subscribers will be wise to place a standing order with their newsdealer for a copy of POPULAR RADIO.

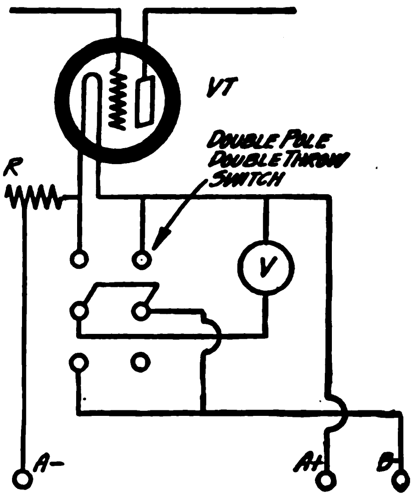
Of course, it is always better to subscribe at $3.00 a year and be SURE of receiving your copy.

Subscription Dept.

POPULAR RADIO, Inc.
119 West 57th Street, New York, N. Y.

How to Build a Transmitter for Less Than $30

(*Continued from page 241*)



A HOOK-UP FOR OPERATING EFFICIENCY

FIGURE 4: *This wiring diagram shows how the voltmeter can be hooked up to serve both as a filament voltmeter and a plate milliammeter.*

leak of from 1,000 to 10,000 ohms resistance. The high-frequency choke coil consists of 60 turns of No. 22 double-cotton-covered wire, wound on a cardboard tube 1½ inches in diameter. The clips on the connection strip are, from left to right, "B" positive, "B" negative, "A" positive and "A" negative.

"Keying" in this set is accomplished either by inserting the key in the negative "B" voltage lead or by inductive coupling on the tenth turn of the primary coil. This tenth turn may be cut away from the other nine by a half-inch gap, and the two key connections are made at each end of the turn. This method of keying makes a key click practically a minus quantity.

The filament voltmeter, a DC instrument reading up to 10 volts, may be used as a plate milliameter by hooking it up as shown in the diagram in Figure 4. It will then read up to approximately 25 milliamperes.

Tuning the set is not difficult, although care should be taken to get maximum results with such a low-powered transmitter. A wavemeter is necessary. The clips on the coils are first set in positions similar to those in the Figures 1 and 3, and the set tuned without an antenna until it reads the correct wavelength on the wavemeter. The antenna can then be attached and the condenser and clips adjusted slightly to give maximum results.

This transmitter has been in use throughout this past winter with a variety of valves, and has maintained constant communication with stations in all parts of this continent, both at night and in daylight, and the results have been excellent.

How to Build the Magnaformer 9-8 Receiver

(*Continued from page 229*)

type valves in all sockets except the two at the right-hand end. Insert a UX-112 type valve in the socket R8, and a UX-171 type valve in the socket R9. The battery cable may now be plugged into the plug-base at the rear of the receiver. This leaves everything ready for operation.

How to Operate the Receiver

The receiver should first be tested to see if the wiring has been done correctly. The filament-control knob, F, is first turned half way "on," or a little more. This should cause the filaments of the four intermediate-frequency amplifier valves and the two low-frequency amplifier valves to light. The two knobs, H and I, on the sub-panel, V, may also each be turned "on" half way, with the result that the balance of the valve filaments should light. If such is the case, the filament-control knob, F, should be turned "off" again and the reproducer and loop connected to the phone tip jacks—S1 and S2 for the loop and S3 and S4 for the reproducer. Now turn the filament-control knob, F, half way "on" again and stations may then be tuned in by slowly turning the tuning control knobs.

When the first signal from a broadcasting station is heard, the two tuning controls should be slightly readjusted, and the filament and volume controls, F and G, on the front panel, U, as well as the two rheostat knobs, H and I, on the sub-panel, V, should each be adjusted for maximum volume. Thereafter the rheostats, H and I, on the sub-panel will require little, if any, attention. All wavelength tuning will be accomplished by means of the two knobs which operate the drum dials, X1 and X2, while the sensitivity and volume of the receiver will be controlled by means of the volume and filament knobs, F and G, on the front panel, U.

The switch, L, at the bottom of the front panel, U, should be left set on figure "8" for all local and semi-distant reception. But for reception from extreme distances, this switch should be set on figure "9." While set on figure "8," this switch disconnects the fourth intermediate-frequency amplifier valve, which means that only eight valves are left in the circuit. When set on figure "9," the nine valves are left operating in the circuit, for distance reception.

* *

Announcers Are Prodded

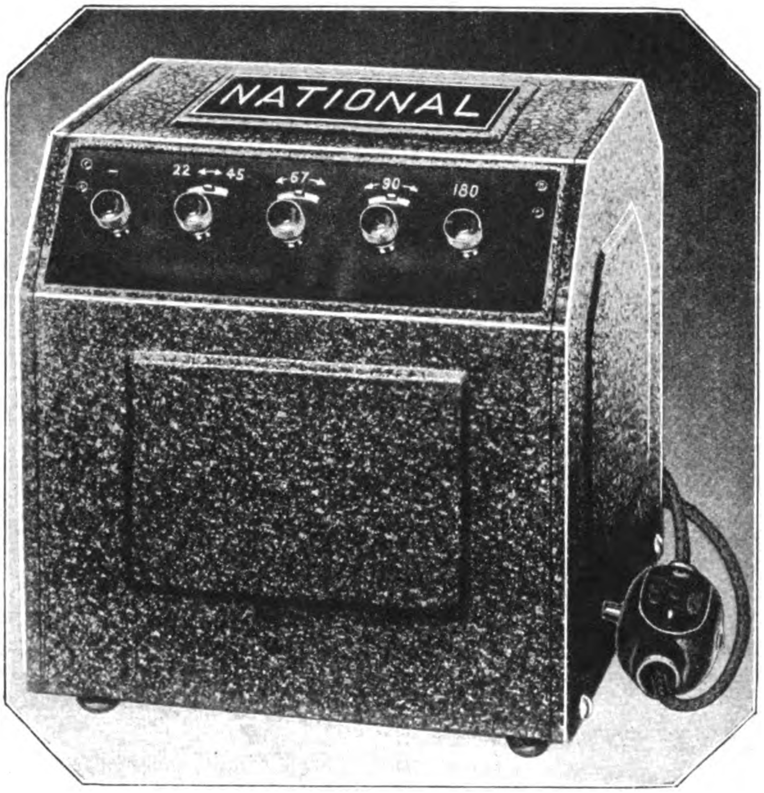
ALTHOUGH intended for an entirely different purpose, the order of the Federal Radio Commission that each station announce its call letters and location as frequently as practicable is the first step ever taken in this country to prod the announcers.

NATIONAL "B"

TYPE 7180

A "B" That's Built for Service

At Booth 5, Section F. F., New York Radio World's Fair
Booths 94 and 95, Boston Show



AN ENTIRELY NEW AND UNIQUE HEAVY DUTY BETTER "B"

SUPPLIES detector voltages from 22 to 45—adjustable;

R. F. voltages from 50 to 75—adjustable;

A. F. voltages from 90 to 135—adjustable.

Power tube voltage, 180 fixed. Limitation of voltage ranges protect tubes and bypass condensers against excessive and harmful loads. *This is an exclusive feature.*

A STRICTLY HEAVY-DUTY POWER UNIT

Output rating is 70 mils at 180 volts. Uses R.C.A. UX-280 or Cunningham CX-380 Rectron. Licensed under patents of Radio Corporation of America and Associated Companies. For 105-115 volts, 50-60 cycles A.C.

List price, with cord, switch and plug, $40.00. Rectifier Tube, $5.00.

DESIGNED FOR LASTING SERVICE, WITH LIBERAL FACTORS OF SAFETY.

N C

Write National Company, Inc., W. A. Ready, Pres., Malden, Mass., for new Bulletin L-123.

Be Sure You Get the Genuine

NATIONAL

RADIO PRODUCTS

Build Bigger Values into Your Radio Set

with YAXLEY
APPROVED RADIO PRODUCTS

Modernize your radio set construction with these two great Yaxley contributions to convenience, efficiency and good appearance.

Automatic Power Control

A new and better power control that cuts in the B eliminator and cuts out the trickle charger when the set is switched on. Cuts out the B eliminator and cuts in the trickle charger when the set is switched off, automatically, unfailingly.

No. 444—Series Type. *With the exclusively Yaxley feature that keeps the voltage drop less than two-tenths (2-10) volts* when used with sets having a current draw equivalent to four 199 type tubes up to eleven 201 type tubes $5.00

Cable Connector Plug

Preserve the neat appearance of your set by centering all battery wires in one neat, compact cable. Safe, simple and sure. Plug is of handsome Bakelite construction. Contact springs of phosphor bronze. Positive contact.

No. 660—Cable Connector Plug, Complete $3.00

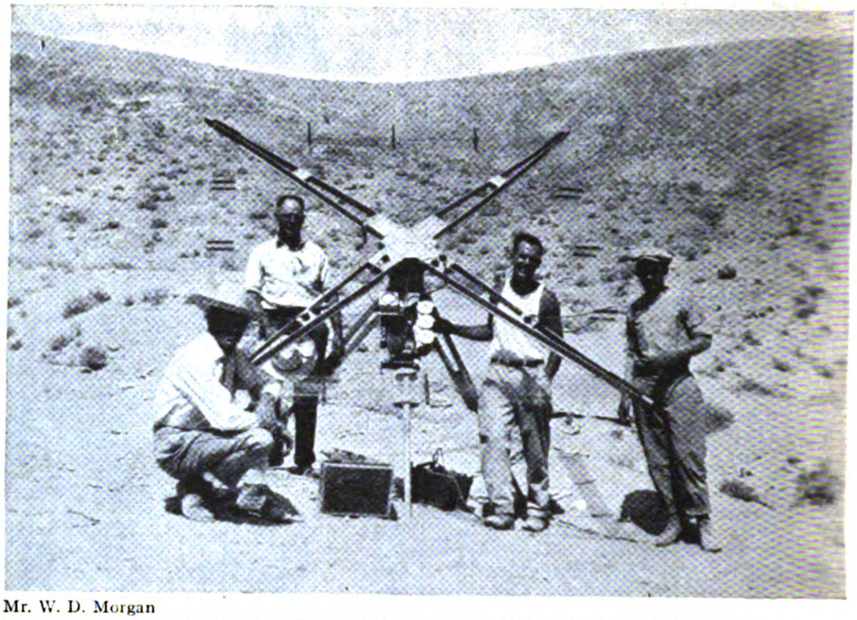
No. 670—Cable Connector Plug, for Binding Post Connections, Complete $3.50

At your dealer's. If he cannot supply you, send his name with your order to

YAXLEY MFG. CO.
Dept. P 9 So. Clinton Street
CHICAGO, ILL.

Radio Hunts for Buried Treasure

(*Continued from page 225*)



Mr. W. D. Morgan

A BROADCASTING STATION FOR RADIO PROSPECTORS

This is the transmitting half of Mr. Morgan's outfit for radio geology, illustrated on a preceding page. Radio waves emitted from the frame antenna are directed downward into the ground. Their detection at distant stations by the receiving outfit may yield indications of underground rock conditions.

nearby radio circuits, but their influence would be much less than that of equal weights of metal fused into a solid mass.

There is one astounding mass of treasure which the soil of Panama is said to conceal and to which this particular difficulty of discovery would not apply. This is the famous "golden Mary."

Legend tells of the presence in Old Panama of a life-size statue of the Virgin Mary, made of solid gold. No treasure such as this would have been overlooked or forgotten by the priests who were its custodians. There is no record of the statue's removal. Indeed, the transportation of so large a mass of gold would have proved enormously difficult for the facilities of the time. Certainly this famous statue is not now extant. Records of recollections of the Church authorities do not disclose its fate. Lieutenant Williams is said to believe, and he may well be right, that this enormous golden treasure still lies buried somewhere underneath the present city. Such a solid metallic mass as this would be an ideal object for the radio treasure finder.

The quantities of gold accumulated by these ancient South Americans are astounding. The Inca of Pizarro's time is recorded to have possessed whole rooms filled with solid gold, piled higher than the height of a man. It is probable that nowhere else in the world and never in the world's history, until the accumulation of the modern gold reserves in the Bank of London and in the Treasury at Washington, has so vast a quantity of the precious metal been gathered in one place as it was in the Inca capital four centuries ago.

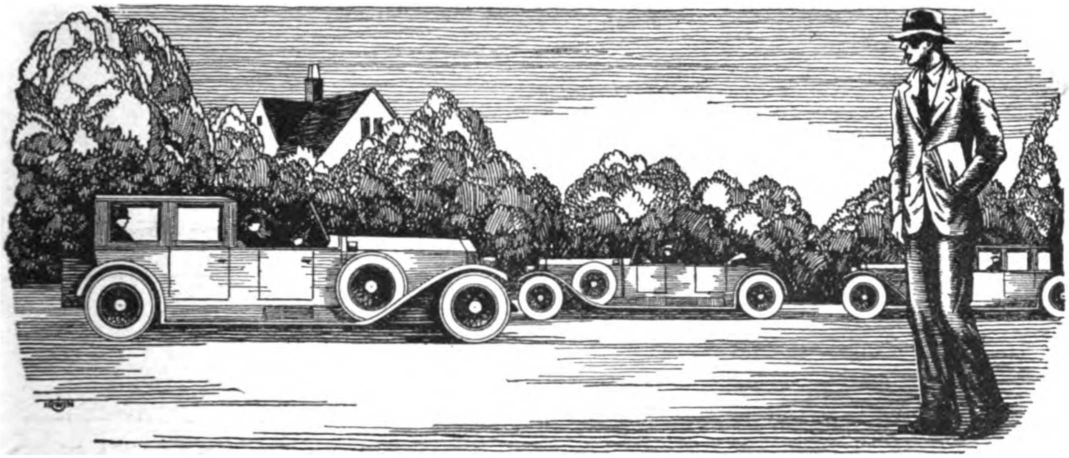
As rapidly as they could, the Spanish conquerors of Peru collected this gold and sent it back to Spain. Up the west coast of South America it went by sailing vessels to Panama. Across the isthmus led one of the famous *Caminos Reales,* or Royal Roads. Over this road mule-trains led by slaves and guarded by men at arms carried the flood of precious metal to the Atlantic and to the galleons which ferried it to Spain.

The city of Old Panama held one of the gates through which this golden traffic had to flow.

Who can doubt that the grandees who sat at that southern end of the Camino Real took toll, as chance might offer, of the gold that filtered through their hands? And it is this treasure that the arm of radio is now reaching out to disclose to man.

How to Operate the Magnaformer

Following the constructional article in this issue, POPULAR RADIO *will run in the November number an article giving complete operating data on the powerful new Magnaformer 9-8 Superheterodyne receiver. This article will give exact information on the proper voltage and current requirements for most efficient service and the best power-packs to use.*



Many times in the old days, while I trudged home after work to save carfare, I used to gaze enviously at the shining cars gliding by me, the prosperous men and women within. Little did I think that inside of a year, I, too, should have my own car, a decent bank account, the good things of life that make it worth living.

I Thought Success Was For Others

Believe It Or Not, Just Twelve Months Ago I Was Next Thing To "Down-and-Out"

TODAY I'm sole owner of the fastest-growing Radio store in town. And I'm on good terms with my banker, too—not like the old days only a year ago, when often I didn't have one dollar to knock against another in my pocket. My wife and I live in the snuggest little home you ever saw, right in one of the best neighborhoods. And to think that a year ago I used to dodge the landlady when she came to collect the rent for the little bedroom I called "home"!

It all seems like a dream now, as I look back over the past twelve short months, and think how discouraged I was then, at the "end of a blind alley." I thought I never had had a good chance in my life, and I thought I never would have one. But it was waking up that I needed, and here's the story of how I got it.

I WAS a clerk, working at the usual miserable salary such jobs pay. Somehow I'd never found any way to get into a line where I could make good money.

Other fellows seemed to find opportunities. But—much as I wanted the good things that go with success and a decent income—all the really well-paid vacancies I ever heard of seemed to be out of my line, to call for some kind of knowledge I didn't have.

And I wanted to get married. A fine situation, wasn't it? Mary would have agreed to try it—but it wouldn't have been fair to her.

Mary had told me, "You can't get ahead where you are. Why don't you get into another line of work, somewhere that you can advance?"

"That's fine, Mary," I replied, "but *what* line? I've always got my eyes open for a better job, but I never seem to hear of a really good job that I can handle." Mary didn't seem to be satisfied with the answer but I didn't know what else to tell her.

It was on the way home that night that I stopped off in the neighborhood drug store, where I overheard a scrap of conversation about myself. A few burning words that were the cause of the turning point in my life!

With a hot flush of shame I turned and left the store, and walked rapidly home. So that was what my neighbors—the people who knew me best—really thought of me!

"Bargain counter sheik—look how that suit fits," one fellow had said in a low voice. "Bet he hasn't got a dollar in those pockets." "Oh, it's just 'Useless' Anderson," said another. "He's got a wish-bone where his back-bone ought to be."

As I thought over the words in deep humiliation, a sudden thought made me catch my breath. Why had Mary been so dissatisfied with my answer that "I hadn't had a chance"? *Did Mary secretly think that too?* And after all, wasn't it *true* that I had a "wish-bone" where my back-bone ought to be? Wasn't that why I never had a "chance" to get ahead? It was true, only too true—and it had taken this cruel blow to my self-esteem to make me see it.

With a new determination I thumbed the pages of a magazine on the table, searching for an advertisement that I'd seen many times but passed up without thinking, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully, and when I finished it I made my decision.

WHAT'S happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, *I've had a Radio business of my own!* At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

NOW I'm making real money. I drive a good-looking car of my own. Mary and I don't own the house in full yet, but I've made a substantial down payment, and I'm not straining myself any to meet the installments.

Here's a real tip. You may not be as bad off as I was. But, think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years, making the same money? If not, you'd better be *doing* something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well-paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. M-86, Washington, D. C.

J. E. SMITH, President,
National Radio Institute,
Dept. M-86, Washington, D. C.

Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesmen will call on me.

Name....................................

Address....................................

Town....................State............

NEW AERO CIRCUITS WORTH INVESTIGATING

The Improved Aero-Dyne 6 and the Aero 7 and Aero 4 are destined to be immensely popular this season!

Here are three new Aero circuits of unusual merit. Each is constructed around a set of improved Aero Universal Coils—the finest and most adaptable inductances ever offered! Learn about them NOW if you are interested in securing finest selectivity, greatest range and power, truest tone quality and best all-around radio reception.

AERO UNIVERSAL
TUNED RADIO FREQUENCY KIT

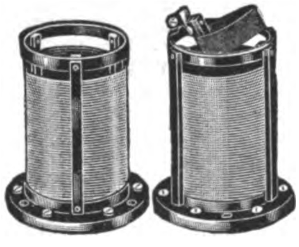
Especially designed for the Improved Aero-Dyne 6. Kit consists of 4 twice-matched units. Adaptable to 201-A, 199, 112, and the new 240 and A. C. Tubes. Tuning range below 200 to above 550 meters.
This kit will make any circuit better in selectivity, tone and range. Will eliminate losses and give the greatest receiving efficiency.

Code No. U-16 (for .0005 Cond.)....... $15.00
Code No. U-163 (for .00035 Cond.)..... $15.00

AERO SEVEN
TUNED RADIO FREQUENCY KIT

Especially designed for the Aero 7. Kit consists of 3 twice-matched units. Coils are wound on Bakelite skeleton forms, assuring a 95% air dielectric. Tuning range from below 200 to above 550 meters. Adaptable to 201-A, 199, 112, and the new 240 and A. C. Tubes.

Code No. U-12 (for .0005 Cond.)...... $12.00
Code No. U-123 (for .00035 Cond.)..... $12.00



AERO FOUR KIT

An exceptionally efficient kit for use in the Aero 4 and other similar circuits. Consists of one Aero Universal Radio Frequency Transformer and one Aero Universal 3-Circuit Tuner. Uses 201-A, 112, 199 and new A. C. Tubes.

Code No. U-95 (for .0005 Cond.)....... $8.00
Code No. U-953 (for .00035 Cond.)..... $8.00

A NEW SERVICE

We have arranged to furnish the home set builder with complete Foundation Units for the above named Circuits and for the Chicago Daily News 4-Tube Receiver and the Aero Transmitter Set, drilled and engraved on Westinghouse Micarta. Detailed blueprints and wiring diagram for each circuit included in foundation units free. Write for information and prices.

You should be able to get any of the above Aero Coils and parts from your dealer. If he should be out of stock order direct from the factory.

AERO PRODUCTS, INC.
Dept. 104
1772 Wilson Ave., Chicago, Ill.

The BEGINNER IN RADIO

CONDUCTED BY ARMSTRONG PERRY

A Radio Mystery Partly Explained

A SPEAKER at a recent meeting of the Institute of Radio Engineers partly explained a mystery that has troubled many men since Adam.

He was discussing loudspeakers. He told how the distribution of harmonics differentiates the various musical instruments, and how the richness of a tone, at its original source or in its reproduction, increased in proportion to the number of harmonics. Then he made this statement:

> The fundamental frequency of a man's voice is of the order of 125 cycles per second, and of a woman's voice 250 cycles. In order to reproduce a man's voice in its full richness, the reproducing device must handle frequencies only as high as 5,000. A woman's voice has more harmonics, so that it would be necessary, in order to reproduce her voice with equal richness, to handle frequencies up to 7,000. That is one reason why it is so hard to understand a woman!

A demonstration was given in which a loudspeaker reproduced speech with harmonics eliminated, in increasing numbers, first at the lower frequencies and then at the higher frequencies. It amused the audience by showing what is the matter with certain types of loudspeakers with which radio broadcast listeners are familiar.

* *

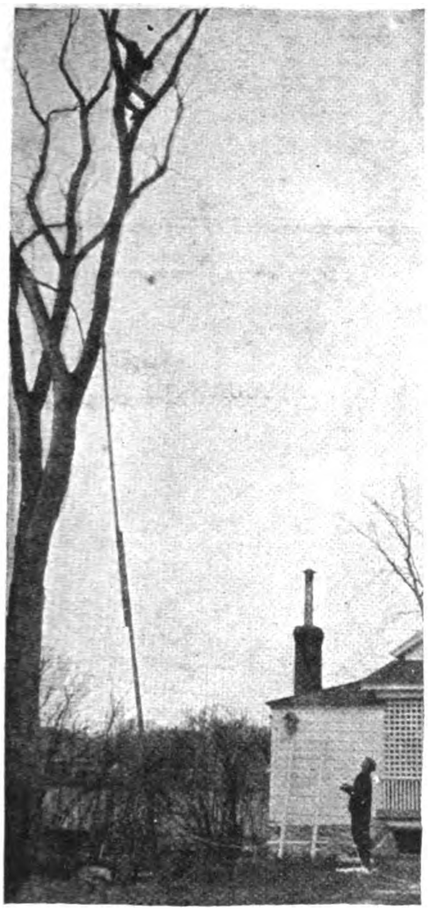
Hints for Stringing Your Aerial

A NEW halyard is likely to kink unless the tendency is removed before the cord is rove through the pulley. Straighten out the whole length of the cord, place it around a tree and have two husky men pull as hard as they can on the ends for five minutes or more. This will stretch the cord and remove the tendency to kink. It is standard practice among men who put up halyards on flagstaffs and aerial masts.

To carry the end of halyard up a tree, tie it to the belt far enough to the rear so that it will not interfere with climbing. Go up a ladder as far as possible,

TEAMWORK MAKES BETTER ANTENNAS

Taking the kinks out of a halyard requires muscle, as this picture shows, but it is important that every part of the antenna have the necessary tautness.



A JOB FOR A "HUMAN FLY"

Rigging antennas in such places as this requires a sure foot and plenty of nerve. Don't try to undertake it unless you know your "limbs."

then shinny up a limb as high as safety will permit. Attach a pulley, put the end of the halyard through it, and run the cord through until a man on the ground has both ends secured.

Men who make a business of this kind of work usually are insured for $10,000 or more. The laws in some states make the owner of the property responsible for accidents to workers, even though the accident may be due to carelessness on the part of the worker. Therefore, workers should not be employed unless they are covered by insurance that relieves the property owner from his responsibility for any accidents that might occur.

Climbing always is subject to some dangers, so—safety first!

* *

A Simple Set for Code Practice

J. W. S., of Alabama, asks how to build an inexpensive receiver for learning code with a view to becoming a commercial operator.

Such a set may be built on a cigar box cover with the following parts:

3-coil mounting with honeycomb coils for the desired wavelengths;

.001 mfd. variable condenser;

Rheostat;

NEW FORMICA KIT PANELS!

Formica panels, handsomely printed in Gold—to enable home set builders to construct radio sets of fine appearance—have been prepared and are now available for the following popular kits:

Magnaformer: Front Panel, 7 x 26 x 3/16", Black Polished; Decorated in Gold; Sub-Panel, 8 x 25 x 3/16", Black Polished; Drilled.

Tyrman: Front Panel, 7 x 26 x 3/16", Dull Walnut; Decorated in Gold; Sub-Panel Ivory, 7 x 26 x 3/16"; Drilled.

Camfield Nine: Front Panel, 7 x 30 x 3/16", Black Polished; Decorated in Gold; Drilled; Sub-Panel, 10 x 29 x 3/16", Black Polished; Drilled.

World's Record Super Ten: Front Panel, 7 x 26 x 3/16", Black Polished; Decorated in Gold; Drilled; Sub-Panel, 10 x 25 x 3/16", Black Polished; Drilled.

Karas (NEW): Front Panel, 7 x 24 x 3/6", Black Polished; Decorated in Gold; Drilled; Sub-Panel, 9 x 23 x 3/16", Black Polished; Drilled.

Other kits include Madison-Moore "One Spot," Mellow-Heald Superheterodyne, World's Record Super Nine, Victoreen (one and two-dial), H. F. L. Nine-in-Line Front and Sub-Panels, Aerodyne, St. James and Infradyne.

THE FORMICA INSULATION COMPANY
4641 Spring Grove Ave., Cincinnati, Ohio

Formica Panels are sold by leading jobbers everywhere.

FORMICA

Formica has a complete service on insulating parts for manufacturers.

FOR RADIO DEALERS ONLY

ROCK BOTTOM PRICES *on everything in Radio*

Only the newest and latest (1927-1928) radio goods; no obsolete products; no "seconds" or sub-standards. All goods of tested and proved quality and established reputation—absolutely guaranteed.

Harry Alter's Radio Book for
OCTOBER
1927
Dealers Only

Get This Wonderful New Price Guide

Compare its money-saving values. Test our "Minute-Man" shipping service with a trial Rush order. Write NOW for your copy of Harry Alter's new "Radio Book."

The Harry Alter Co.
1766 Michigan Avenue
CHICAGO

Announcing

finer reception—through a finer audio transformer

MODERN

TYPE M

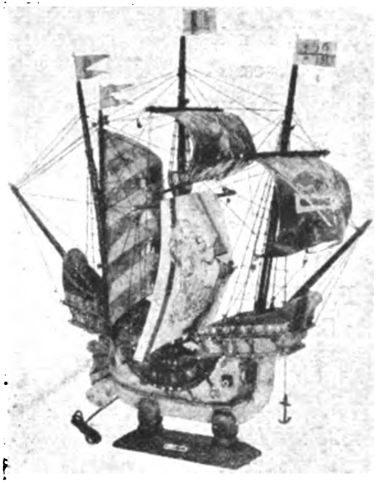
A new standard of perfection in audio amplification. High inductance, perfect proportioning, and liberal core sizes give uniform amplification as low as 30 cycles and eliminate high harmonics. Satisfactory performance is guaranteed. Install Type M in your set.

First and second stage $8.50 each; Push-pull $10.00 each; Output $8.00 each.

If your dealer cannot supply you order direct by mail

THE MODERN ELECTRIC MFG. CO.
Toledo, Ohio

RADIO'S
Greatest Triumph



Size: 26" high; 12" wide; 27" long (overall)

THE MELODY SHIP

You can put these ship model loud speakers together in a few hours of pleasant pastime

You need not know anything about ship building or loud speakers to assemble one of these models. As a matter of fact if you have never seen a ship you can put the ship model loud speaker together in a few hours by following our diagrams and instruction sheet which is so written that a school boy can understand it. All you need is a small hammer. The parts are numbered on the diagram to make the process even more simple. As long as you can understand such instructions as these (actually taken from assembling chart that is included with every model) you cannot fail: "Take No. 57, place it in front end of No. 56 and tap lightly with hammer. Next take No. 58 and place it up against No. 57 and tap with hammer to bring it into place."

Easy? Nothing simpler. The instructions are just like that from the beginning to end. Do this and that—and before you realize it a beautiful model has grown before your eyes.

The MELODY SHIP is made entirely of wood. A positive free edge cone speaker with a unit of the electro magnet type, powerful enough to operate a 72-inch cone, is attached to the main-mast. This insures splendid service and ample volume with no distortion.

The loud speaker is made in the shape of a sail and does not alter or change the appearance of the ship in any way. The sails are artistically painted with the various designs and figures of the period represented by the models.

The tone of this loud speaker is far superior to any cone of its size on the market today. This is made possible by our patented melody sail.

Write for our beautiful illustrated catalog.

Fill in the coupon below and we will act upon it immediately.

MINIATURE SHIP MODELS
3818-20-22-24 Baring Street
Philadelphia, Pa.
Canadian Branch: 1485 Bleury St., Montreal, Canada

MINIATURE SHIP MODELS, DEPT. W
3818-20-22-24 Baring St., Phila., Pa.

Please send me the complete parts, for the loud speaker ship model cut to fit, and ready to assemble for the La Pinta as shown above. I will pay postman $12.50 plus postage (a few cents).

PLEASE PRINT NAME AND ADDRESS PLAINLY

Name..
Street or R. F. D...............................
City ....
State..

Fleet

A RECEIVER THAT YOU CAN PACK IN YOUR GRIP

By changing the honeycomb coils (shown in the center of the picture) it is possible to tune all the way from the broadcast range to the longer waves of the commercial transmitters.

Grid-leak and condenser;
Valve and socket;
Phones;
"A" and "B" batteries.

It may be made even more simple by using a single honeycomb coil and mounting. A 1500-turn coil, shunted by a .001 variable condenser, will tune from 14,500 to 26,500 meters and bring in many of the high-power commercial stations. In shunt or in series it will bring in enough stations to provide plenty of practice.

These stations will give a beginner excellent code practice. Some of them use high-speed automatic sending apparatus, but there are always some on the air sending by hand at slow speed. Often each word is repeated. Under favorable conditions foreign stations are received on one tube with a set of this kind.

A simple and efficient circuit to use is the time-honored De Forest ultra-audion. Tracing this from the aerial downward, the connections are as follows:

Aerial to coil and grid-leak;
Grid-leak to grid;
Other end of coil to plate, phones and stator of variable condenser;
Rotor of condenser to negative terminal of "B" battery, negative terminal of "A" battery, and ground.

The positive terminal of the "A" battery connects with the rheostat, and the other end of the rheostat with the filament. The negative terminal of the "A" battery connects with the remaining filament terminal. The final connection, made after all others are checked up and found correct, is between the positive terminal of the "B" battery—which is the danger spot in all hook-ups—and the phones.

Only two double binding posts are needed and these can be eliminated by using other connectors. The tips of the phone cords can be attached directly to the plate terminal of the tube socket and to the positive terminal of the "B" battery if tips or terminals are provided with clips.

This set has several advantages. Coils of any size can be plugged in. A 600-turn coil will bring in the American end of the transatlantic radio telephone conversations, which may be interesting because of the novelty of the new service, although otherwise they are as deadly dull as all other one-sided conversations. A 100-turn coil brings in the ship-to-shore and ship-to-ship traffic. A 50-turn coil tunes to the broadcasting wavelength, but a condenser of lower capacity is needed to make the music and voices distinct.

This outfit may be built for $25.00 or less. Any type of receiving valve can be used. With low-voltage valves and small dry batteries, it is light and easy to carry in a grip. A short length of wire put up in any convenient place usually is enough of an aerial to bring in the high-power commercial stations.

* *

A Unique "Circuit Building Contest"

A circuit building contest was conducted at a recent gathering of the American Radio Relay League and caused much merriment. Try it at one of your social gatherings.

Each contestant was given a sheet of paper, mimeographed, with spaces at the top for his name and call letters. Then followed these directions:

> Draw as many diagrams as possible from the apparatus listed below. No single piece of apparatus may be used more than once in any one circuit, but any one piece of apparatus may be used in any number of different circuits. Each diagram must be in working condition, and each must be labeled.
>
> 1 antenna
> 1 ground
> 3 receiving tubes
> 3 rheostats
> 1 6-volt "A" battery
> 1 pair of phones
> 1 "B" battery, variable to 90 volts
> 2 .0005 mfd. variable condensers
> 4 air core receiving coils
> 2 low-frequency transformers
> 2 sockets
> 2 high-frequency chokes
> 1 grid-leak and condenser

Radio apparatus was given as prizes.

All Electric Radio

The Randolph

7 Tubes-*Single Control*

JUST plug this Randolph Radio into the electric light socket—and tune in. A powerful, selective radio that gives dependable coast to coast reception. **No batteries, chargers, eliminators, acids or liquids.** Here is complete radio satisfaction whenever you want it. The easy tuning with one control brings on all stations. Illuminated drum allows you to operate the radio in the dark and has space for logging stations. Every detail of the Randolph is modern and perfected—it is the utmost in radio—unsurpassed regardless of price. It is this wonderful radio that you test and try for 30 days FREE before you buy. Listen to it in your own home. When it convinces you by actual performance it is the ideal radio—the one you have always hoped for—**you can buy it direct at factory prices.** Be sure you write for free descriptive literature today.

30 DAYS FREE TRIAL

6 Tube $55 Retail Price

Biggest Discounts To Agents

Beautiful Ampliphonic Console

Illustrated here is one of the beautiful Randolph Seven Console Models—made of the finest carefully selected heavy solid walnut, hand-rubbed and with burl finish. Has built-in genuine large cone speaker that compares with any on the market. Assures unlimited reception of high notes and low notes clear as a bell. Completely electric—**uses no batteries of any kind.** Be sure you send for fully illustrated, full color folder giving complete details.

Genuine Walnut Cabinets

The finest of heavy, genuine, solid burl finish walnut is used in the making of all Randolph cabinets. No picture can do them justice. You must see them to appreciate them.

6-Tube Radio

New, modern, single-control, six-tube radio. Do not compare this set with old-style, 2-dial, 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers. Comes in beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated drum with space for logging. Absolutely dependable and very selective. **Send for 30 days free trial. You test it before you buy.**

All Sets Guaranteed

Biggest Discounts to Agents

Work either full or part time and make big money. Sensationally big discounts to agents. No experience required. Randolph All-Electric Sets sell on first demonstration. Tremendous advertising campaign helps you. Men and women both make big money this way. Demonstrating set sent on 30 Days TRIAL. WRITE NOW for proposition.

USE THIS COUPON TODAY!

Randolph Radio Corporation
711 West Lake Street, Dept. 116
Chicago, Illinois

Send me full particulars about the RANDOLPH Six and Seven-Tube Electric and Battery Table and Console Sets with details of your **30 Day FREE Trial Offer.**

Name..

Address...

City..............................State...............................

Mark here ☐ if interested in Agent's proposition.

RANDOLPH RADIO CORPORATION
711 West Lake Street Dept. 116 Chicago, Ill.

Bradleyunit-A
PERFECT FIXED RESISTOR

Unaffected by temperature, moisture or atmospheric changes. Does not age or change in resistance.

A solid-molded fixed resistor, baked under high pressure, and accurately calibrated. Can be soldered without affecting accuracy.

Two Remarkable Radio Resistors

Bradleyunit-A is an outstanding success! It is a fixed resistor for radio circuits of all kinds, and has a capacity of 2 watts. It is rugged and can be soldered easily, without affecting the rating of the unit.

Bradleyohm-E is widely used by manufacturers of B-Eliminators for plate voltage control. Its remarkably wide, noiseless range, accomplished with two columns of graphite discs, accounts for its tremendous popularity.

Use Allen-Bradley resistors in your own hook-ups for superlative results. Follow the example of prominent radio manufacturers. They know!

Bradleyohm-E is available in several ranges and ratings. Sold in distinctive checkered cartons. Ask your dealer for Bradleyohm-E

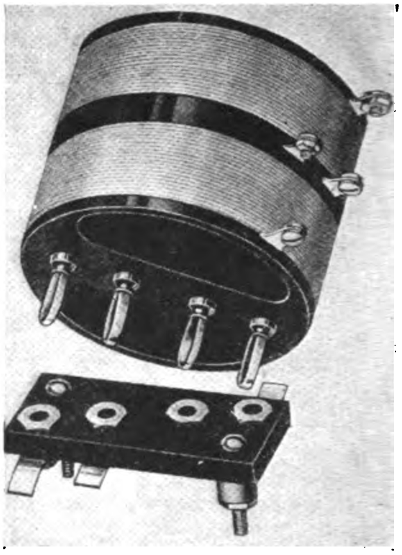
Allen-Bradley Co.
ELECTRIC CONTROLLING APPARATUS
276 Greenfield Ave. A-B Milwaukee, Wis.

Coils for the Home-Built Set

OLD-timers recall several types of inductance coils, each of which was in vogue for a season.

Straight wound coils were the first; they were simple to wind, and oatmeal boxes or cardboard tubes for forms were available everywhere. Longer waves began to be used for long-distance commercial services and the straight wound coils lengthened to as much as three or four feet. Sometimes the wire was wound one layer over another to make the coils shorter, but such bank winding introduced effects that some experimenters found undesirable.

The honeycomb coil created quite a furor. Its turns are put on in layers but they are well spaced and adjacent turns cross each other at angles that reduce the undesirable capacity between turns to low values. A 1500-turn honeycomb coil, which tunes up to 26,500 meters, is only about 4⅛ inches in diameter and all sizes are made of the uniform width of about one inch.



AN EFFICIENT PLUG-IN COIL AND MOUNTING

This type of coil is practical, efficient and substantial. It is obtainable in three or four sizes for covering the wavebands between 30 and 600 meters.

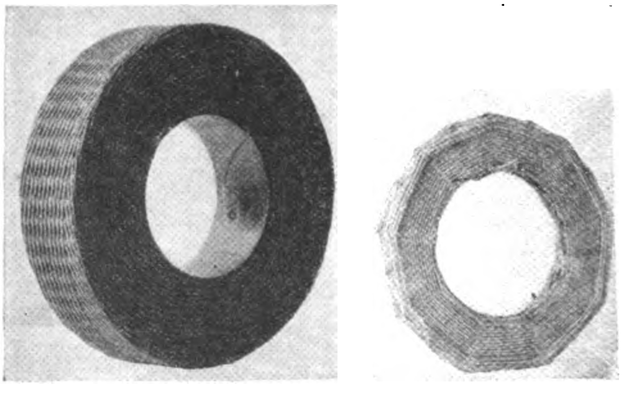
The radio amateurs were forced down to the 200-meter band with their traffic, and honeycomb coils lost some of their popularity because they were less efficient on these lower wavelengths. Straight wound coils for the 200-meter band were made to resemble the honeycombs. Spiderweb, basket-weave and similar light, flat coils were developed.

Still more recently, the manufacturers of radio apparatus started the "low loss" propaganda, which applied to coils, condensers and about everything that went into the set. There was one good idea and a lot of bunk in this hobby, which was ridden nearly to death. It is desirable to be rid of losses, but in some of the "low loss" coils a very small amount of dielectric resistance was eliminated by winding the coils "on air" while a much greater wire resistance was added in order to make the coils retain their shape without a supporting form or core.

These mistakes in coil design may have resulted from a previous error—the idea that metal end plates were necessary in low-loss condensers. Radio engineers have shown that dielectric losses at high frequencies in coils or condensers can be made smaller than the losses caused by any known method of eliminating the dielectric. It all depends on good design and good dielectric.

The length and size of the wire in an inductance coil are the principal factors in determining its resistance. A circular coil has more inductance for a given length of wire than a coil of any other shape. Up to a certain point, resistance is reduced by increasing the size of the wire, but if the wire is too large the resistance is increased. No sizes of wire can be specified for all frequencies because the resistance depends to some extent on the frequency, or wavelength, received.

The most efficient coil for use in a broadcast receiver is said by many experts to be one wound on a cylinder of cardboard, pure bakelite or other



HONEYCOMB AND BASKET-WEAVE COILS

The honeycomb coil at the left is capable of tuning up to 20,000 meters. The same coil if wound as a solenoid would be several feet long. The coil at the right is one of the "low-loss" type, which uses no solid support in its make-up other than the wire itself.

Quietness The Carborundum GRID-LEAK

REG. U. S. PAT. OFF.

SLIP a Carborundum Grid-Leak into your set and you will notice an improved reception instantly.

Carborundum Grid-Leaks are quiet. They are dense solid rods of Carborundum that provide for an uninterrupted flow of current.

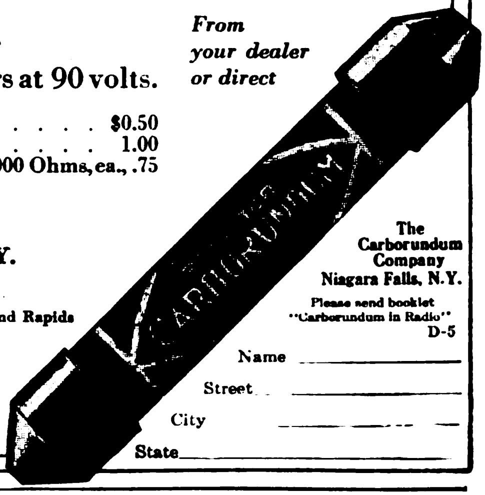
No chance for the creation of minute noisy arcs—no glass tube. They can't disintegrate. They are unbreakable.

All standard values, both Grid-Leaks and Fixed Resistors.

The Grid-Leaks are tested for values at 5 volts—the Resistors at 90 volts.

No. 77 Carborundum Grid-Leaks, values 0.25, 0.50, 1 to 10 Megohms, each	$0.50
No. 79 Carborundum Resistors, values 2500 and 5000 Ohms, each	1.00
No. 79 Carborundum Fixed Resistors, values 12,000, 25,000, 50,000, 75,000 and 100,000 Ohms, ea.	.75

From your dealer or direct



THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.
CANADIAN CARBORUNDUM CO., LTD., NIAGARA FALLS, ONT.
Sales Offices and Warehouses in
New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Milwaukee, Grand Rapids
The Carborundum Co., Ltd., Manchester, Eng. Deutsche Carborundum Werke, Dusseldorf, Ger.

[Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of The Carborundum Company.]

The Carborundum Company
Niagara Falls, N.Y.
Please send booklet "Carborundum in Radio"
D-5

Name ______
Street ______
City ______
State ______

A NEW A. C. SUPERHETERODYNE

Described in the

December POPULAR RADIO

Here is an article, fresh from the Laboratory, describing in detail the construction of a 6-tube AC Superheterodyne Pack for use with the LC-28 Unipac. It is AC throughout and amazingly simple to build. No serious fan can afford to miss this issue of POPULAR RADIO.

$3.00 sent to the Subscription Department guarantees the safe arrival of each new issue.

POPULAR RADIO, INC.
119 West 57th Street, New York, N. Y.

Quick and easy tuning—more volume, clearness, stability, with an X-L VARIO DENSER in your circuit.

Specified and endorsed by foremost radio designers in all latest and best hook-ups.

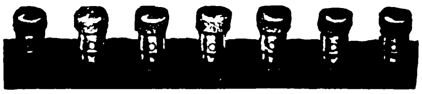
MODEL "N"—Micrometer adjustment easily made, assures exact oscillation control in all tuned radio frequency circuits. Neutrodyne, Roberts 2-tube, Browning-Drake, Silver's Knockout. Capacity range, 1.8 to 20 Mfd. Price, $1.00.

MODEL "G"—Obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in superheterodyne and positive grid bias in all sets. Capacity range, Model G-1, .00002 to .0001 Mfd. Model G-5, .0001 to .0005 Mfd. Model G-10, .0003 to .001 Mfd. Price, each, with grid clips, $1.50.

X-L PUSH POST—Push it down with your thumb, insert wire, remove pressure, wire is firmly held. Vibrations will not loosen, releases instantly. A push post that excels in appearance, action, service and convenience. Price, each, 15c.

PUSH POST PANEL—7 push posts mounted on black insulating panel with permanent white markings. Soldering lugs, raising bushings, screws for mounting, etc., in box complete. Price, $1.50.

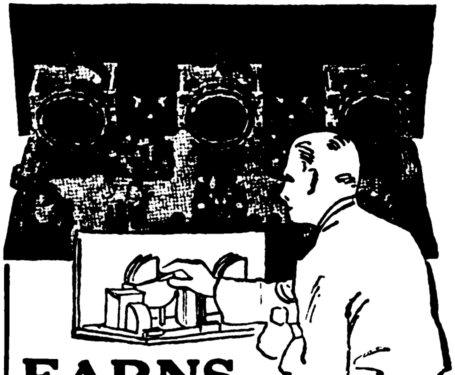
X-L Push Post



X-L Push Post Panel

FREE—New, up-to-date book of wiring diagrams showing use of X-L units in the new LOFTIN-WHITE constant coupled radio frequency circuit, and in other popular hook-ups. Write today.

X-L Radio Laboratories
2422 Lincoln Ave., Chicago, Ill.



EARNS $500.00 In His Spare Hours

That's the record of Member Lyle Follick, Lansing, Mich. Member Werner Eichler, Rochester, N. Y., writes, "I have made over $50 a week in my spare time."

With its proven money making plans, advice, co-operation in furnishing parts at wholesale and training, the Radio Association of America is helping its members start radio stores, secure better positions, increase their salaries, earn $3 an hour upwards in spare time building sets and serving as radio "doctors."

Join the Association without delay, because we have a plan whereby your membership may not—need not—cost you a cent. Only a limited number of these memberships are acceptable. Write before it's too late.

RADIO ASSOCIATION OF AMERICA
Dept. PR 10-4513 Ravenswood Ave., Chicago

Send me your book and details of your Special Membership Plan.

Name..........
Address..........
City.......... State..........

Kept Cool—

Like An Air-Cooled Engine!

TRUVOLT

An All-Wire Variable Voltage Control

Truvolt, a wire variable high resistance of special mechanical construction, is air-cooled on the same principle as air-cooled engines. This results in a greater radiation area and adapts it especially for B-Eliminators and power devices.

1. Made entirely of wire; permanently accurate and lasts indefinitely.
2. Permits potentiometer control; positive metallic contact at all times.
3. Nichrome wire resistance—very low temperature coefficient. Wound on an asbestos-covered enamel core.

Type	Ohms Resistance	Milliamperes Current
T-5	0 to 500	224
T-10	0 to 1,000	153
T-20	0 to 2,000	112
T-50	0 to 5,000	71
T-100	0 to 10,000	50
T-200	0 to 20,000	35
T-250	0 to 25,000	32
T-500	0 to 50,000	22.5

Eight stock types with resistances up to 50,000 ohms. All rated at 25 watts.

List $3.50 each

Also full line of fixed wire resistances.

Write for FREE circular

"This Is An Eliminator Year"

Dept. 18, 175 Varick Street
New York, N. Y.

ELECTRAD Inc

good dielectric, with its length about equal to its diameter. The preferred sizes of wire are 20 to 26. Such coils have been found, in laboratory tests, to have only about half the resistance of some alleged "low loss" coils with no dielectric. The effect of the dielectric has been tested by removing the cardboard or bakelite tubes and in some cases the change in resistance could hardly be measured even by the most sensitive instruments.

Those who use plug-in coils, in order to facilitate changes of wavelengths, should not expect as high efficiency as can be secured by well-made soldered connections, but if the plug-in connections are kept bright and the contact tight, the difference may be so slight that the ear of the operator will not detect it.

It is natural to want to be up to date and have the latest types of apparatus, but there is fun in winding hay wire on an oatmeal box to make a coil while waiting for money to buy something better. Some of today's experts and millionaires were doing it only a few years ago. All the older types of coils are as efficient now as they ever were and there is good experience in making and testing them. There are radio stations on all wavebands from less than 5 meters to more than 20,000 meters, and even a crude set will bring in some of them if the fundamental principles of radio are followed.

* *

Around the Dial

By FRANK ROMANO

(*When everyone carries his own portable broadcasting set*)

"—dog, come on, seven—it's the best bargain of the day, Madam, shall I—and a quarter's worth of liverwurst, *my*, how I like *liverwurst*—No, she did *not* shoot to *kill*—But your *honor*, I was only doing a hundred and eighty miles per hour—did you see *that?* Why, I never saw the man in my *life*—und he set: 'You make a pet on dot horse, und I set: 'Shoosh, how couldt I make a pet, I'm not a champermate'—Gentlemen!!!! Remember you *are* gentlemen—oh, tell them we're not home—How much? Two dollars? Why, I can get the very same quality at Dinkelspiel's for a dollar ninety-eight—yeh, I saw it in POPULAR RADIO—Oh, Sadi-e-e-e-e-e-e, come in der house once, tell der mens to vait—O, solo, mio-o-o-o—Poiper-poiper, Mister? Wuxtree prepaw!—Thanks, I shall—here he comes now—when he gits up under dis post, sap him wid de pipe, now—oh, say, cul, turn off y'er set, it's on—all right, you bet—Good morning, Harry, how—."

—FRANK ROMANO

* *

RADIO is described by United States Senator Dill of Washington as "one-way mass communication."

Now!

TELEVOCAL TUBES for A. C. Sets

Electrify your set with the new Televocal A. C. 226 and A. C. 227 Tubes. Using these tubes, you can operate on A. C. current without "A" Batteries. Thoroughly tested; genuine Televocal quality; guaranteed.

Also use Televocal T. C. 112 and T. C. 171 Power Tubes. Now made with an oxide-coated filament, current consumption is reduced ½—from ½ to ¼ amperes.

Televocal Tubes are made in all standard types

TC 201A TELEVOCAL

TELEVOCAL CORP'N,
Televocal Building,
Dept. F-1 588 12th St.
West New York, N. J.

TELEVOCAL QUALITY TUBES

CARTER

New Vitreous Enamel Resistors

½ SIZE

These Resistors are wire-wound and coated with a vitreous enamel which protects the wire from mechanical injury and oxidation.

This hard, glassy enamel has the same rate of expansion as the procelain tube and the resistance wire that is wound on it. Consequently the Resistor may be operated at high temperatures without damaging it.

These Resistors are guaranteed permanently accurate within 5 per cent. of rated value.

Resistors from 750 to 20,000 ohms, two types: 2" long, dissipating 20 watts, 4" long, dissipating 40 watts.

In Canada: Carter Radio Co., Ltd., Toronto

Offices in principal cities of the world

MEMBER RMA

Carter Radio Co. CHICAGO

What Radio Is Doing for Aspiring Musicians

RADIO is doing a tremendous service to young and aspiring musicians; it is "discovering" future stars, no matter how humble their environment, in great numbers. From the depths of the unknown they are being dug out, given hearings and boosted faster than through any other medium.

For example, take Jane Upperman.

Miss Upperman was unknown save in the little Kentucky town in which she lived and where she sang in a little church choir. She is tall, blonde, imposing, of splendid stage appearance. And she can sing, too. But for a long time it looked as if nobody in the outside world would ever know of her. Then WSAI, at Cincinnati, "discovered" her, took her into their studio as their *protégé* and had her voice registered over the air. So her fame has spread. Now she is under the training of one of the best vocal masters in New York City, and he has been so impressed with the possibilities of her beautiful *coloratura* voice that he has undertaken to teach her without pay and also to finance her training in Europe.

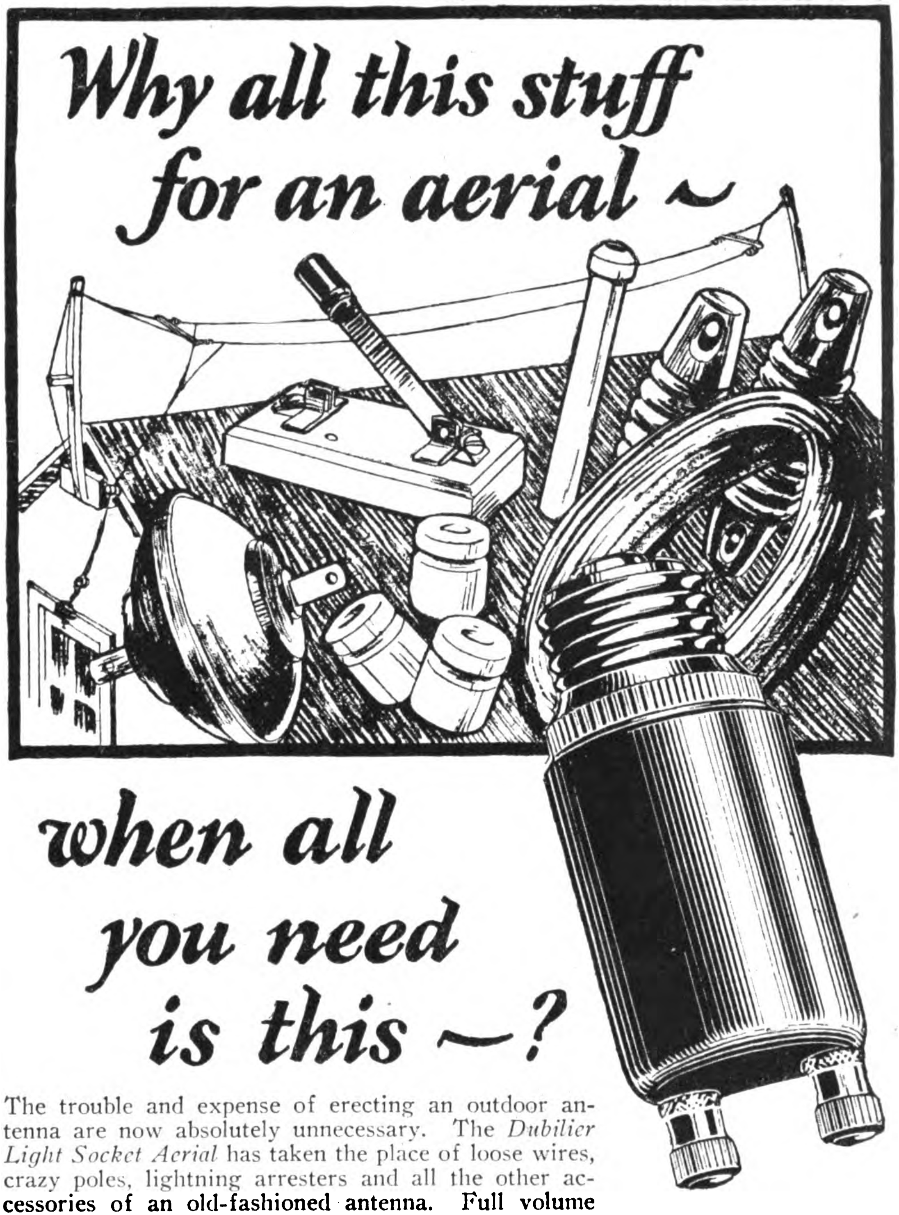
WCCO, at Minneapolis-St. Paul, also boasts a "find" in Howard Melaney, who has just quit shoveling coal on a Northern Pacific locomotive running between Glendive and Forsythe, Montana. He is a tenor of such promise that the WCCO announcers speak of him as "The Mountain McCormack." He has always enjoyed singing, but up to a short time ago he had no training other than what he could give himself and what he could get in the church choirs that he joined from time to time. It took about all he could earn on his railroad job to support his mother, his younger brother, a sister and himself. Through many a small economy he scraped together enough money to buy a phonograph and records of his favorite tenors. During the evenings he could spend at home he played these records over and over again, so that he might study the voices and their technique and so improve his own voice.

"Then," as they say at WCCO, "one day last winter he burst in on us."

That very evening Melaney was singing before the microphone. During the next week hundreds of applause letters swept into the office with requests for "more from Melaney."

But the fireman had to keep on his job for a while. He stoked the furnace on his favorite engine, singing at intervals from WCCO. But his name spread fast, and before long he found his time mostly taken up with calls for concerts and theatrical performances. And it was his income from these that finally made it possible for him to give up his railroad job and study music in earnest.

—RAYMOND HENDERSON

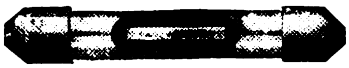

Why all this stuff for an aerial ~
when all you need is this ~?

The trouble and expense of erecting an outdoor antenna are now absolutely unnecessary. The *Dubilier Light Socket Aerial* has taken the place of loose wires, crazy poles, lightning arresters and all the other accessories of an old-fashioned antenna. Full volume is guaranteed. So is clarity and distance. You'll find, too, that this remarkable device greatly reduces both static and interference. Convince yourself without risk—all dealers sell the Dubilier Light Socket Aerial on a 5-day money-back basis.

Price $1.50

Dubilier Approved Blocks for Power Units

If you're building an A-B-C eliminator, insist on the high factor of safety found only in the approved Dubilier condenser blocks. Raytheon and all standard circuits provided for.



The Accurate Dubilier Metaleak

Don't underestimate the importance of accurate and quiet tubular leaks in the performance of your receiver. Metaleak is smaller than most, but interchangeable on any standard mounting. All resistances — 40c to 65c.

You'll like the new Dubilier Micadon

A new shape and moulded Bakelite case have made the "Standard Fixed Condenser of Radio" a better and better-looking Micadon. Fully protected from injury and outside capacity. Terminals adapted to screwed or soldered connections.

Prices 45c to $1.50

DUBILIER CONDENSER CORPORATION
4377 Bronx Blvd. New York

Dubilier Condensers

The Coil's the thing that makes Radio!

NO RADIO UNIT IS ANY BETTER THAN ITS COIL

The performance of Battery Eliminators, Audio Transformers, Loud Speakers, and all other Radio Units is in exact ratio to the efficiency of their windings. **It's the Coil that does the work!**

Nearly all leaders in radio and radio parts use Dudlo Coils because they know their superiority.

DUDLO

Dudlo Manufacturing Corporation
FORT WAYNE, INDIANA

SENSATIONAL NEWS!

—for YOU—Mr. Dealer—
in our Big—New 1928 Catalog

THIS is the Greatest **MONEY SAVING** Radio Catalog. It describes the best in radio—shows how you can **SAVE MONEY.** Contains all the latest radio information. Write for your copy today. It's free.

New Kits featured include: Aero—Bodine—Camfield—Citizens—H-F-L—Infradyne—Karas—Melo—Heald—Scott's—Silver Marshall—St. James—Tyrman—etc.

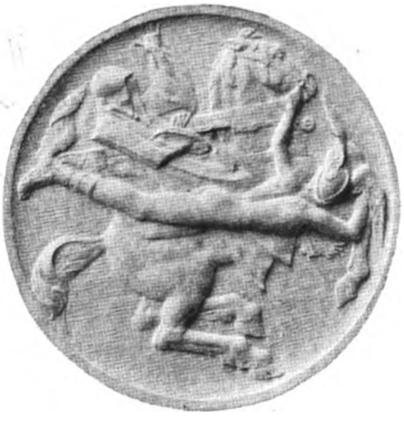
TELMACO

Established 1918

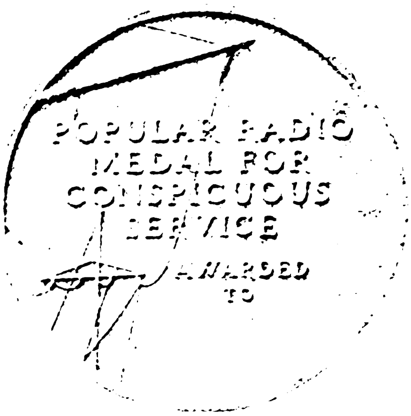
TELEPHONE MAINTENANCE CO.
123-L South Wells Street **Chicago, Illinois**

CHICAGO'S OLDEST RADIO HOUSE

WHOLESALE ONLY.



The obverse of the medal; the original is two-and-one-half inches in diameter.



The reverse; the name of each recipient will be engraved in the space provided.

The Popular Radio Medal *for* Conspicuous Service

TO every radio amateur, to every amateur experimenter and broadcast listener, who is instrumental in alleviating human suffering or saving human life, directly through the medium of radio, recognition will hereafter be extended in the form of a medal that shall be known as "The Popular Radio Medal for Conspicuous Service." This medal is unique within the realms of radio, in that it shall be awarded not for scientific achievement or invention, but for service to humanity.

To insure a fair and unbiased consideration of all claims, a Committee of Awards has been appointed that includes five distinguished citizens of international fame. To assist this Committee of Awards, an Advisory Committee has been appointed that numbers among its members some of the most eminent citizens of the United States, including representatives of many of our most distinguished institutions.

The conditions under which the medal will be awarded are here specified:

1. The medal shall be known as the Popular Radio Medal for Conspicuous Service.
2. The medal shall be awarded, without discrimination as to sex, age, race, nationality, color or creed, to those radio amateurs, radio experimenters, broadcast listeners and other non-professionals through whose prompt and efficient action radio is utilized to perform an essential part in the alleviation of human suffering or in the saving of human life within the territorial confines of the United States and its possessions, or in the waters thereof.
3. The medal shall be awarded by a Committee of Awards that shall not exceed five in number. No member of this Committee shall be an employee, officer or stockholder of POPULAR RADIO, INC., nor shall any such employee, officer or stockholder have a vote in the deliberations of the Committee.
4. An Advisory Committee, which shall co-operate with the Committee of Awards and which shall be particularly charged with the responsibility of making recommendations for awards of this medal, shall be made up of men and women who, because of their interest in the public welfare or because of their connection with institutions that are consecrated to public service, are in positions to bring to the attention of the Committee of Awards the exploits of candidates who are within their own special fields of activity.
5. The medal will be awarded for services rendered since Armistice Day, November 11, 1918.
6. Recommendations for awards may be submitted to the Committee of Awards at any time and by any person. Every recommendation must contain the full name and address of the candidate, together with a detailed account of the accomplishment on which the proposed award is based, and must be accompanied by corroboratory evidence from persons who have first-hand knowledge of the circumstances and whose statements may be verified to the satisfaction of the Committee of Awards.
7. The medal will be awarded to as many individuals as qualify for it and at such times as the Committee of Awards may authorize.
8. All considerations not specified herein shall be left to the discretion of the Committee of Awards.

All communications to the Committee of Awards may be addressed to—

The Secretary of the Committee of Awards, POPULAR RADIO Medal for Conspicuous Service, 119 West 57th Street, New York.

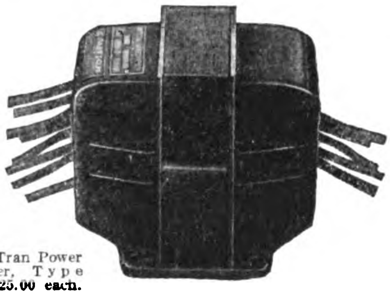
The Committee of Awards

HIRAM PERCY MAXIM, *President of the American Radio Relay League.*
E. F. W. ALEXANDERSON, *Chief Consulting Engineer of the Radio Corporation of America.*
MAJOR GENERAL CHARLES MCK. SALTZMAN, *Chief Signal Officer of the Army.*
REAR ADMIRAL W. A. MOFFETT, *Chief of the Bureau of Aeronautics, U. S. Navy.*
DR. JOHN H. FINLEY, *publicist and journalist.*
Secretary: Dr. E. E. Free, 119 West 57th Street, New York.

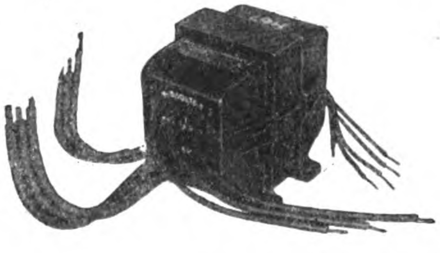
Advisory Committee

SENATOR JAMES W. WADSWORTH, JR., *of New York.*
HON. JOHN BARTON PAYNE, *Chairman, American Red Cross.*
ADOLPH LEWISOHN, *publicist.*
JUDGE BEN S. LINDSAY, *late of the Juvenile and Family Court, Denver, Col.*
DR. J. MCKEEN CATTELL, *Past President, American Association for the Advancement of Science.*
DR. J. H. DELLINGER, *Past President, Institute of Radio Engineers.*
FARLEY OSGOOD, *Past President, American Institute of Electrical Engineers.*
C. E. GRUNSKY, *Past President, American Society of Civil Engineers.*
DR. DAYTON C. MILLER, *President, The American Physical Society.*
W. L. ABBOTT, *President, The American Society of Mechanical Engineers.*
W. J. HOLLAND, *President, Carnegie Hero Fund Commission.*
GEORGE K. BURGESS, *Director, Bureau of Standards.*
COLIN H. LIVINGSTONE, *Past President, Boy Scouts of America.*
DANIEL C. BEARD, *Chairman, National Court of Honor, Boy Scouts of America.*
MISS SARAH LOUISE ARNOLD, *President, Girl Scouts.*
DR. W. D. HAGGARD, *President, American Medical Association.*
K. A. BICKEL, *President, United Press Association.*
KENT COOPER, *General Manager, The Associated Press.*
H. P. DAVIS, *Vice-President, Westinghouse Electric & Manufacturing Company.*
DR. VERNON KELLOGG, *General Secretary, National Research Council.*
JESSE LYNCH WILLIAMS, *Past President, Authors' League of America.*
PROFESSOR GEORGE B. PEGRAM, *Dean of the Faculty of Applied Science, Columbia University.*
PROFESSOR H. H. SHELDON, *Professor of Physics, New York University.*
WM. HAWLEY ATWELL, *Grand Exalted Ruler, Order of Elks.*
PROFESSOR EDWIN B. WILSON, *Harvard University, National Academy of Science.*
W. E. HARKNESS, *Vice-President, American Telephone & Telegraph Company.*
WILLIAM L. SAUNDERS, *President, United Engineering Societies.*
COL. J. R. MCQUIGG, *Past Commander, The American Legion.*
JOHN R. MOSS, *President, Kiwanis International.*
W. D. TERRELL, *Chief Supervisor of Radio, Department of Commerce, Washington, D. C.*

AMERTRAN AMERTRAN



The AmerTran Power Transformer, Type PF-281, $25.00 each.



AmerTran Filament Heating Transformer, Type H-67, $12.00 each.

New Transformers *for* A. C. Power Supply

As in audio transformers, AmerTran products stand first in the power transformer field. They are up-to-date in design, well-made and dependable.

Type PF-281, illustrated above, becomes virtually an A-B-C eliminator when used with AC tubes and the proper filter circuit for DC voltages of from 425 to 650 volts, plate current 110 milliamperes. This unit is designed for use with the new UX-281 rectifying tube, and has a 750 volt plate winding which enables it to be used with a UX-281 or 216-B rectifying tube. In addition, there are filament heating windings for the new AC tubes. Therefore, this single unit will convert AC house current into filament and plate current, and grid bias potential. Used with AmerChokes in the filter circuit, a receiver may be constructed to operate entirely from the house lighting circuit.

Transformer, type H-67, is intended for use with the new RCA UX-226 raw AC amplifier tubes and the new UY-227 detector tube. It also has a third filament winding capable of handling two UX-171 tubes. In connection with the new AC tubes, the type H-67 becomes the power source for the filament and is therefore a real "A" battery eliminator.

If you have a good plate supply system and a set with the new AC tubes and one or two UX-171 power tubes in the last stage, the H-67 AmerTran is ideal, transforming the 50 or 60 cycle, 110 volt AC house light current down to the lower voltages for the correct operation of the new tubes.

Write for booklet, "Improving the Audio Amplifier," and data on Power Supply Units.

AMERICAN TRANSFORMER CO.

178 EMMET STREET NEWARK, N. J.

We also make Audio Transformers, Choke Coils, and Resistors. Sold at any authorized AmerTran dealer.

American Transformer Company Transformer Builders for Over Twenty-Six Years

ACME Celatsite Wire

Tinned copper bus bar hook-up wire with non-inflammable Celatsite insulation, in 9 beautiful colors. Strips easily, solders readily, won't crack at bends. Sizes 14, 16, 18, 19; 30 inch lengths.

Flexible Celatsite for sub-panel wiring

A cable of fine, tinned copper wires with non-inflammable Celatsite insulation. Ideal for sub-panel or point-to-point wiring. Strips easily, solders readily. Nine beautiful colors; *sold only in 25 ft. coils, in cartons colored to match contents.*

Spaghetti Tubing

Oil, moisture, acid proof; highly dielectric — used by leading engineers. Nine colors, for wire sizes 12 to 18; 30 inch lengths. (We also make tinned bus bar, round and square, in 2 and 2½ ft. lengths.)

Stranded Enameled Antenna

Best outdoor antenna you can buy. Seven strands of enameled copper wire. Presents maximum surface for reception, resists corrosion; this greatly improves the signal. Outside diameters equal to sizes 14 and 16. (We also offer solid and stranded bare, and stranded tinned antenna.)

Loop Antenna Wire

Sixty strands of No. 38 bare copper wire for flexibility, 5 strands of No. 36 phosphor bronze to prevent stretching. Green or brown silk covering; best loop wire possible to make.

Battery Cable

A rayon-covered cable of 5, 6, 7, 8 or 9 vari-colored Flexible Celatsite wires for connecting batteries or eliminator to set. Plainly tabbed; easy to connect. Gives set an orderly appearance.

Send for folder
THE ACME WIRE CO., Dept. P
New Haven, Conn

ACME WIRE
MAKES BETTER RADIO

WITH THE EXPERIMENTERS

CONDUCTED BY S. GORDON TAYLOR

A System for the Rapid Matching of Units

THE experimenter often wants to know if certain units match—or rather, how closely they do match. A simple example of this problem is presented when a set of high-frequency coils have been constructed.

The chances are that these coils are to be used with a set of tuning condensers all of the same capacity and the same type. If the coils match when they are connected in their respective circuits, these circuits will match and the dial readings for any particular station will be approximately the same.

If these coils could be matched by some rapid, simple means, it would save the constructor much time. Usually when unmatched coils are placed in a set, it is necessary to take off turns of wire from one or more of the coils until the dial settings are approximately the same for a given station.

Possibly a more important use of matching is found in the case of intermediate-frequency transformers for superheterodynes. The home constructor often wishes to build his own intermediates, and they must be matched before reasonable results can be expected from the set.

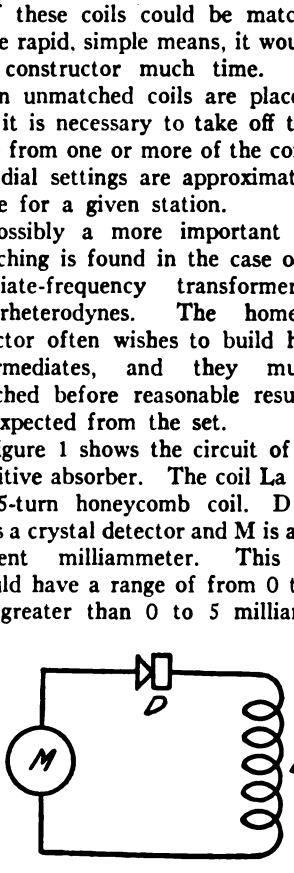
Figure 1 shows the circuit of a very sensitive absorber. The coil La may be a 25-turn honeycomb coil. D represents a crystal detector and M is a direct-current milliammeter. This meter should have a range of from 0 to 1, or not greater than 0 to 5 milliamperes. The honeycomb coil should be connected on a cord so that it may be conveniently coupled with the unit to be matched. This circuit of Figure 1 is aperiodic and will respond to any frequency. The purpose of the crystal is to rectify the current and allow it to flow through the circuit in but one direction. This absorber is so sensitive that coupling with high-frequency stage will produce heavy deflection of the meter M.

Figure 2 represents a simple oscillator that may be used in conjunction with the absorber in Figure 1. Any high-frequency oscillator will do. The one in Figure 2 is simple to construct; coils Ls and Lp may be of the honeycomb type and therefore may be changed for varying wavebands.

The coil Ls should be mounted on an extension cord so that it can be easily coupled with the unit under test. 25- to 50-turn honeycomb coils will cover the broadcast range, while coils in the order of 400 turns will be necessary in peaking the intermediate-frequency transformers of superheterodynes.

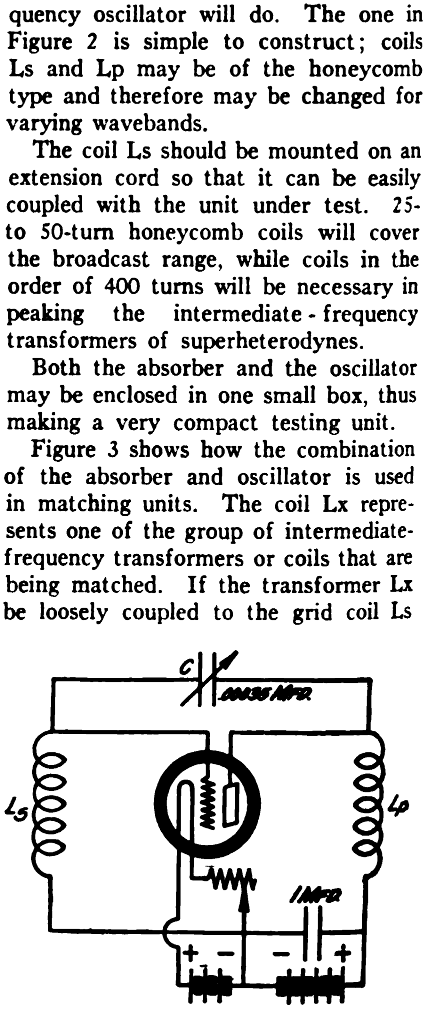
Both the absorber and the oscillator may be enclosed in one small box, thus making a very compact testing unit.

Figure 3 shows how the combination of the absorber and oscillator is used in matching units. The coil Lx represents one of the group of intermediate-frequency transformers or coils that are being matched. If the transformer Lx be loosely coupled to the grid coil Ls



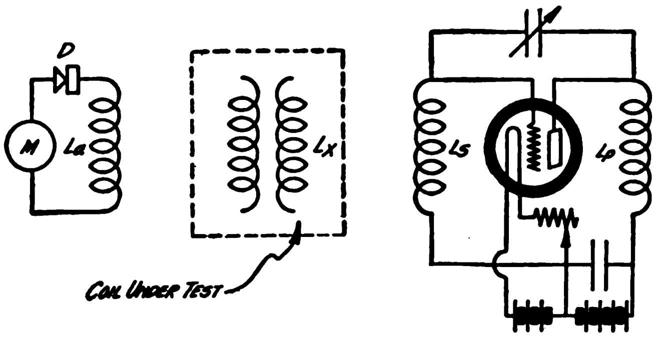
A SENSITIVE RESONANCE INDICATOR

FIGURE 1: *When the coil La is placed close to a high-frequency circuit, the meter M will indicate a flow in this circuit. Resonance of the tuned circuit with a third (driver) circuit is indicated by the maximum deflection of the meter.*



A SIMPLE OSCILLATOR CIRCUIT

FIGURE 2: *The oscillator circuit shown above may be installed with the absorber circuit shown in Figure 1 in a small instrument box.*



THE COMPLETE HOOK-UP FOR TESTING COILS

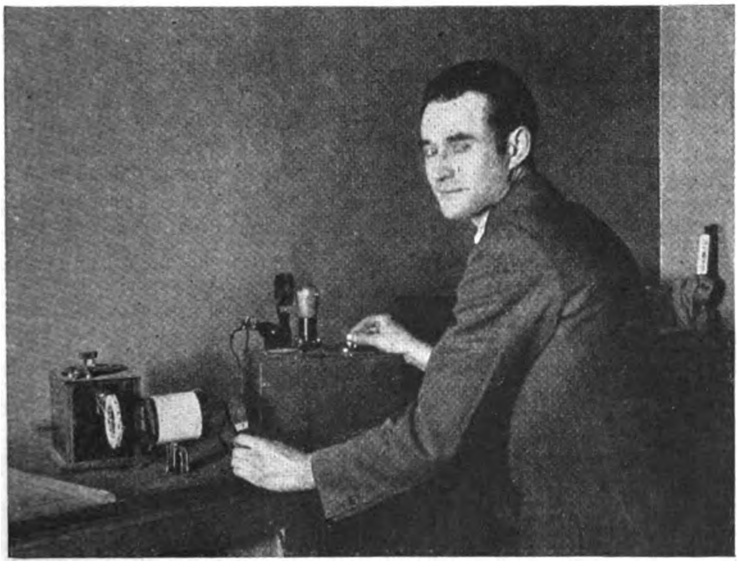
FIGURE 3: *In matching coils, they should all show resonance at the same setting of the oscillator tuning condenser, shown at the upper right-hand corner of the diagram.*

of the oscillator and also coupled on its opposite side to the absorber coil La, when the tuning condenser C of the oscillator is turned, the meter M of the absorber will read a maximum at one particular setting of C. At this point the oscillator circuit is tuned to resonance with the natural frequency of the unit that is being tested. The reason for this is quite evident when we stop to consider what energy transfer actually takes place. For any given setting of the condenser C of the oscillator, the oscillator will develop a current of a given frequency. Since the grid coil Ls is loosely coupled with transformer Lx a certain amount of energy will be transferred to Lx. The amount of this energy depends entirely on how closely the frequency being sent out by the oscillator corresponds to the fundamental of Lx.

When the two absolutely correspond, maximum current will be transferred to Lx. Since La of the absorber is also loosely coupled to Lx, the absorber will have a certain current flowing in its circuit, this amount being dependant upon the amount of current transferred from Ls to Lx. It is therefore evident that when Ls and Lx are in resonance the absorber circuit will have maximum current flowing and the meter M will read a maximum.

Care should be taken that both Ls and La couple very loosely with the transformer Lx. If they couple too closely, it will be hard to determine when Ls and Lx are really in resonance. Extreme care should be taken that La and Ls do not couple directly. If this coupling should take place, it will be extremely hard to find the resonant point between Ls and Lx.

To actually match a set of coils the resonant point of each coil should be tested and the condenser scale reading of the oscillator unit noted for each coil. It will be found that one transformer will have the lowest reading on C of the oscillator, meaning that this particular transformer is of the lowest wavelength of the set. The other transformers should now be tested again, one at a time, and wire should be taken off their secondaries until they all read at the same point on C. It is much easier to take wire off the secondaries and match them all with the lowest transformer than it is to take one transformer at random and match the others to it, putting wire on some to gain this



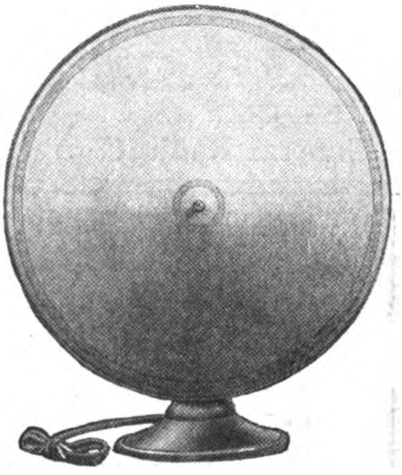
THE TESTING OUTFIT IN OPERATION

FIGURE 4: *Here is the deviser of this system, Mr. Thomas McKay, testing a coil. Note the compactness of the device.*

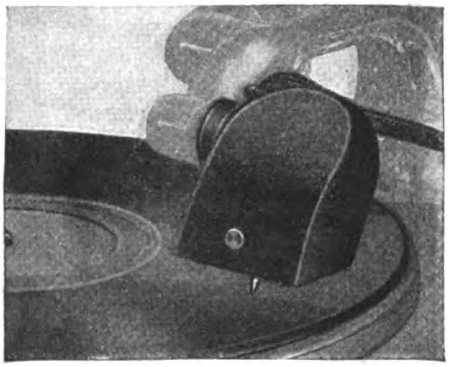
The NEW Moorish design Pacent Cabinet Cone in two-tone antique finish mahogany $35.00

TONE QUALITY
is their outstanding feature

THESE three *new* Pacent products bring a new and keener enjoyment of radio by the true fidelity and realism of their reproduction.



The new 17-inch Pacent Balanced Cone establishes a new standard in cone speaker performance $22.50



The Pacent PHONOVOX (electric pickup) attached to your phonograph and radio, reproduces records with the tone quality rivaling the electric phonograph . . . $12.50

Ask your dealer for a demonstration or write us if dealer doesn't handle.

Pacent
RADIO CORPORATION
156 W. 16th Street, New York City

4 Adjustable "B" Voltages
in any combination

From 0 to 180
also adjustable "C" Voltages

From 0 to 50
Type 445 Plate Supply

Price $55.00

The New
GENERAL RADIO PLATE SUPPLY
Embodying new and distinctive features in plate supply design

1. *Adjustable wire wound resistance with sliding taps* which control voltages so that any combination of voltages from 0 to 180 may be taken from the four positive "B" terminals. This method of voltage control is superior to the use of several resistances with exterior knob controls. It has the advantage that once the sliding taps are adjusted to the proper operating voltages of the tubes, they are tightened in place by thumb screws and voltages will remain constant, but are immediately available for readjustment whenever the unit is used with a different set.
2. *Adjustable "C" voltage for power tube.*
3. *High voltage test condensers in filter circuit.*
4. *Uses UX-280 or CX-380 rectifier tube* which has maximum output of 100 milliamperes, thereby providing sufficient current for sets of the multi-tube type.
5. *Automatic cut-out switch* breaks the 110 volt A. C. circuit when cover is removed for adjusting voltages or connecting wires to taps, thereby making unit absolutely safe even in the hands of persons not familiar with electrical apparatus.
6. *Designed to meet the specifications adopted by the National Board of Fire Underwriters.*
7. Absolutely guaranteed against mechanical and electrical defect upon leaving the General Radio factory.

Cost, which has been a secondary consideration to over-all efficiency has been kept as low as peak performance and production economies permit.

Price from your dealer, or direct from the factory if your dealer cannot supply you:

Type 445 Plate Supply Unit	$55.00
Type UX-280 or CX-380 Rectifier Tube for above	5.00

Licensed by the Radio Corporation of America only for Radio Amateur, Experimental and Broadcast Reception.
Under terms of R. C. A. license, unit may only be sold with tube.

General Radio Company - - - Cambridge, Mass.

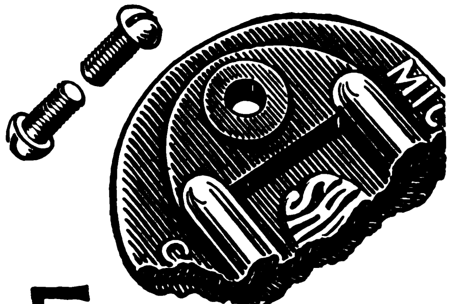
BIG RADIO CATALOG

From the "Big, Friendly Radio House"

NEW 1928 Book offers finest, newest well-known sets; parts, eliminators, accessories at lowest prices. Set-builders, dealers, agents—

Write for this Catalog!

Western Radio Manufacturing Company
136 West Lake St. Dept. 57
CHICAGO, ILL.



EASY
to use

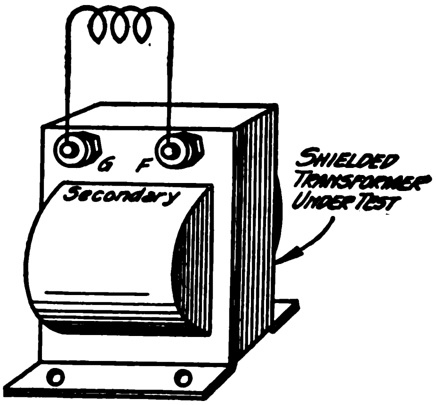
Accurate rating, permanent capacity value, high D. C. resistance—low self inductance are characteristics of Sangamo Mica Condensers.

In addition, they are easy to use! One may solder directly to the terminals, or pass bus-bar through them, use lugs, or mount the condenser with machine screws — all with the knowledge that the condenser will not be injured and that connections are permanent!

Sangamo Electric Company
Springfield, Illinois

6336-5

SANGAMO
MICA CONDENSERS



THE METHOD FOR SHIELDED CIRCUITS

FIGURE 5: *An external pick-up (the coil shown above the transformer) must be added in testing transformers that are shielded in metal cases. The same pick-up coil should be used with all the transformers to be matched.*

match point and taking wire off others.

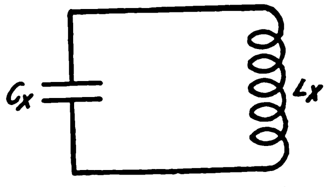
Using the system just described it is not necessary to calibrate the oscillator against a standard. This is a distinct advantage. In matching the filter transformer to a set of intermediate transformers it is simply necessary to substitute various fixed condensers across this filter primary until the desired point is reached. Condensers of the open type may be cut down until this proper capacity is found.

The above discussion holds only for transformers not built in a metal case. For transformers of the metal enclosed type a different system must be employed, as shown in Figure 5. A 25-turn honeycomb coil, Lx, is connected across the secondary terminals of the transformer. This coil is now used to couple with the oscillator and absorber and the testing is continued as before.

Figure 6 shows a system of matching fixed capacities such as small fixed condensers. The condenser to be tested should be hooked to any standard coil, Lx, as shown in the figure. Suppose it is desired to see how closely together a series of small fixed .00025 mfd. condensers match. These condensers would be tested one at a time and the resonant point on C of the oscillator would be found.

This matching system may be applied to numerous specific cases and it is found a handy and rapid method.

THOMAS L. MCKAY.

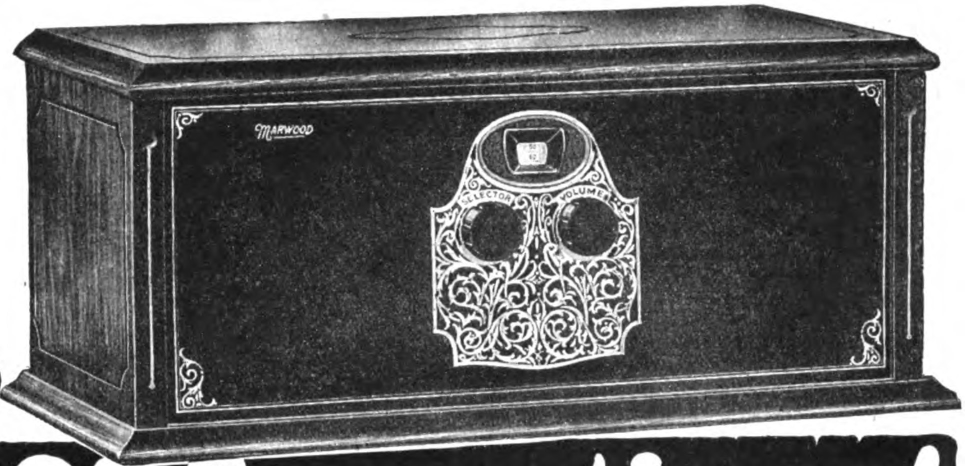


THE HOOK-UP FOR MATCHING CONDENSERS

FIGURE 6: *Using the same coil, Lx, all condensers of equal capacity will show resonance at the same setting of the oscillator tuning condenser.*

30 Days FREE TRIAL
5 Year Guarantee

MARWOOD



The 1928 Sensations!
8 Tube-1 Control

ALL ELECTRIC
8 Tube
1 Control
$98 RETAIL PRICE

Big Discount to Agents From this Price

Has Complete A-B Power Unit

A REAL ALL ELECTRIC Radio with one of the best A-B power units on the market—no batteries needed—at the world's lowest price. This Marwood can't be excelled at ANY price. If you have electricity in your home, just plug into the light socket and forget batteries. No more battery trouble and expense. Costs less than 2c a day to operate. Always have 100% volume. ALL ELECTRIC Radios are high priced because they are new. We cut profit to the bone and offer a $250.00 outfit for $98.00 retail price. Big discount to Agents. Don't buy any Radio 'till you get details of this sensational new ALL ELECTRIC Marwood.

All Electric
or Battery Operation

AGAIN Marwood is a year ahead—with the Radio sensation of 1928—at a low price that smashes Radio profiteering. Here's the sensation they're all talking about—the marvelous 8 Tube Single Control Marwood for BATTERY or ALL ELECTRIC operation. Direct from the factory for only $69.00 retail price—a price far below that of smaller, less powerful Radios. Big discount to Agents from this price. You can't beat this wonderful new Marwood and you can't touch this low price. Why pay more for less quality? To prove that Marwood can't be beat we let you use it on 30 Days' Free Trial in your own home. Test it in every way. Compare it with any Radio for tone, quality, volume, distance, selectivity, beauty. If you don't say that it is a wonder, return it to us. We take the risk.

New Exclusive Features

Do you want coast to coast with volume enough to fill a theatre? Do you want amazing distance that only super-power Radios like the Marwood 8 can get? Do you want ultra-selectivity to cut out interference? Then you must test this Marwood on 30 Days' Free Trial. An amazing surprise awaits you. A flip of your finger makes it ultra-selective—or broad—just as you want it. Every Marwood is perfectly balanced—a real laboratory job. Its simple one drum control gets ALL the stations on the wave band with ease. A beautiful, guaranteed, super-efficient Radio in handsome walnut cabinets and consoles. A radio really worth double our low price.

Buy From Factory—Save Half

Why pay profits to several middlemen? A Marwood in any retail store would cost practically three times our low direct-from-the-factory price. Our policy is highest quality plus small profit and enormous sales. You get the benefit. Marwood is a pioneer, responsible Radio, with a good reputation to guard. We insist on the best—and we charge the least. If you want next year's improvements NOW—you must get a Marwood—the Radio that's a year ahead.

AGENTS

Make Big Spare Time Money

Get your own Radio at wholesale price. It's easy to get orders for the Marwood from your friends and neighbors. Folks buy quick when they compare Marwood quality and low prices. We want local agents and dealers in each territory to handle the enormous business created by our national advertising. Make $100 a week or more in spare time demonstrating at home. No experience or capital needed. We show you how. This is the biggest season in Radio history. Everybody wants a Radio. Get in now. Rush coupon for 30 Days' Free Trial, beautiful catalog, Agents' Confidential Prices and Agents' New Plan.

MARWOOD RADIO CORP.
5315 Ravenswood Avenue
Department A-2, Chicago, Illinois

Only $69 RETAIL PRICE
Big Discount to Agents From This Price

Get Our Discounts
Before You Buy a Radio

Don't buy any Radio 'till you get our big discounts and catalog. Save half and get a Radio that IS a Radio. Try any Marwood on 30 Days' Free Trial at our risk. Tune in coast to coast on loud speaker with enormous volume, clear as a bell. Let your wife and children operate it. Compare it with any Radio regardless of price. If you don't get the surprise of your life, return it. We take the risk. Don't let Marwood low prices lead you to believe Marwood is not the highest quality. We have smashed Radio prices. You save half.

6 Tube—1 Control

This is the Marwood 6 Tube, 1 Control for BATTERY or ALL ELECTRIC operation. Gets coast to coast on loud speaker with great volume. Only $47.00 retail. Big discounts to Agents. Comes in handsome walnut cabinets and consoles. This low price cannot be equalled by any other high grade 6 tube Radio. Has the volume of any 7 tube set. If you want a 6 tube Radio you can't beat a Marwood and you can't touch our low price.

$47
RETAIL PRICE
Big Discount to Agents from This Price

Rush for Free Trial

MARWOOD RADIO CORPORATION,
5315 Ravenswood Ave., Dept. A-2, Chicago, Ill.
Send Agents' Confidential Prices, 30 Days' Free Trial, New Catalog and Agents' New Money Making Plan. No obligation on my part.

Name..

Address..

St. or R.F.D...

City..............................State..............

6 TUBE RADIO
ONE DIAL Only $32.50

Latest advanced circuit. All-steel chassis, totally shielded. Balanced parts of best quality. Marvelous power and selectivity. Gets the long-range stations as clear as a bell. One-dial single control. Encased in cabinet of fine finish and rare beauty. Here is a value unsurpassed in the realm of radio—just one of the mighty bargains listed in my new catalog. Get full details before you buy any radio. An unsurpassed value—just one of our many mighty bargains.

FREE Catalog, Log and Call Book

It's just off the press! Chock-full of radio's latest and best 1928 developments. 132 pages of real radio information. Lists all the latest receivers, eliminators, chargers, speakers, kits, parts, etc. All the radio stations and newly assigned wave lengths. A regular encyclopedia of Radio information. And it's Free! Send for your copy today.

AMERICAN RADIO BARGAINS

AMERICAN AUTO & RADIO MFG. CO.
Harry Schwartzberg, Pres.
Dept. 282 American Radio Bldg., Kansas City, Mo.

Listed by Underwriters' Laboratories

For Good Appearance

Sticks, poles and wires atop the house never add beauty. Aerial wires inside are unsightly.

ELECTRAD Lamp Socket Antenna $1.00

Eliminates aerials. Screws in any outlet. Uses no current. Neat, efficient and SAFE. Tested at 2500 volts A.C.

At your dealer's or write

Dept. 60, 175 Varick Street,
New York, N. Y.

ELECTRAD INC

Heat Proof Resistors for "ABC" Power-Packs

THE rapid gain in popularity of the new "ABC" power-pack circuits has created a need for resistors of much greater current capacity than any thus far used in radio receiving sets. These new circuits dissipate much more energy in the resistances than has been the case in circuits used heretofore. This is obvious when we consider that we are now dealing with a pressure of 300 volts and a current of .3 to .4 ampere, while in the past, high voltages have been used for "B" battery circuits only, where the current seldom exceeds .06 ampere.

To have a sound understanding of the new resistances needed, it is advisable to refer to some of the fundamental laws of resistance in electrical circuits. The following laws are simple and accurate. They should be in every radio experimenter's notebook.

1. The *ohm* is the unit for measuring electric resistance. A resistance of one ohm in a conductor will cause a pressure drop of one volt at a current of one ampere.

2. *Ohm's Law* is a simple equation to determine resistance, current, or voltage drop in an electric circuit. If "I" is the current in amperes, "E" is the voltage drop through the resistance, and "R" is the resistance, the following relations are all expressed by ohm's law:

$$I = E/R$$
$$R = E/I$$
$$E = I \times R$$

3. The *watt* is the unit of electric power. It represents the energy expended when one ampere flows through a resistance of one ohm or through a drop of one volt. The amount of energy expended in any resistance, therefore, is the current in amperes multiplied by the drop in volts.

4. Electric energy is dissipated in a resistance as heat, and the amount of heat is in direct proportion to the watts of electric energy dissipated, regardless of the shape or kind of material used in the resistor. Rheostats or fixed resistors that are to dissipate a large amount of energy, therefore, must have ample size to radiate the heat generated, and must be constructed throughout of material that will withstand the temperatures that develop while in operation.

Rule No. 4 has been relatively unimportant in receiving circuits of the past, because the amount of energy dissipated by any single resistor was small. For example, a filament rheostat, controlling two UX-201-a type valves from a 6-volt storage "A" battery, will normally be required to dissipate about one-half watt. This energy is so small that almost any rheostat, regardless of size, will handle it without dangerous heating.

A little later in radio history there came a demand for fewer panel controls and it was partially answered by controlling the filaments of all the valves in the set with the same rheostat. For a 6-valve set, using one one-half-ampere power tube, this required a normal dissipation of slightly over 2 watts in the rheostat. Many of the small rheostats used in the older sets could not carry the current without burning out. New and larger rheostats of low resistance designed for this service were frequently called "heavy duty." These rheostats may confuse many purchasers today, because while satisfactory for the purpose for which they were designed, the maximum energy they are able to dissipate without breaking down usually does not exceed 10 watts.

The ordinary wire-wound rheostat does not break down because the wire burns out, for it is normally wound with the same kind of wire used in electric heaters that operate continuously at a red heat. However, the wire is wound on and insulated by fibre, for that material can easily be wound flat and then bent into the required shape. Since this fibre is covered up by the wire, however, it has little radiating surface and becomes the hottest part of the rheostat. The limiting factor, therefore, is the temperature at which the fibre breaks down. Fibre disintegrates slowly at the boiling point of water, 212 degrees Fahrenheit, and more rapidly at higher temperatures.

Most resistors needed for the new "ABC" power-pack circuits must dissipate from 18 to 35 watts normally, and should be capable of dissipating up to 50 watts for a short period of time to guard against burning out through an accidental short-circuit of the equipment. While it is possible to manufacture a conventional radio type of rheostat to dissipate this amount of energy at a temperature within the safe limit of fibre, it is scarcely practical, because such a rheostat must be so very large in size that it is difficult to find space enough for it in ordinary radio equipment. The alternative is to wind the resistance on material that will withstand high temperatures.

One good example of the new heat-proof construction is the new Centrolab variable resistors. In these instruments nichrome resistance wire is wound on a metal strip insulated by asbestos. This metal strip is then formed into the rheostat frame. It is welded to the contact shoe support in such a way that the entire assembly is practically heat proof, while the wire is open to free air circulation.

In conclusion it is evident that practical resistors for the new high current circuits should be wire wound, have a large area for heat dissipation, and be heat-proof in construction.

—H. E. OSMUN.

What Voltage Rating Means in Paper Condensers

Two things should be noted in considering filter condensers for radio power applications, namely, the voltage rating and the capacity. The latter has to do with the electrical size of the device, but the former is more important in that it determines the reliability under given working conditions.

The making of high-voltage paper condensers is a relatively new art, which may account for the lack of established standards. Radio standardization committees have, thus far, contented themselves by specifying an undirectional working voltage for continuous duty for standard paper condensers of 150, 300, 500, 750 and 1,000 volts, and specifying that the standard 15-second single test shall be twice these voltages. However, long experience with condenser technique teaches us that the test specified is of little consequence beyond disclosing a virtually short-circuited condenser. Several times the rated working voltage should be employed for the test; and even so, these flash tests mean very little so far as reliability and long life are concerned.

The foundation of the paper condenser is a pure rag paper manufactured in mills specializing in this kind of paper stock. The paper, which resembles a thin bond paper, is produced in continuous rolls of the requisite width. Yet despite the most scrupulous care of the paper makers, the product has tiny metal particles and invisible defects which present weak electrical spots when incorporated in a condenser. In the research laboratory engineers examine samples of paper and get the "count" on the defects per square foot, which must not exceed a certain maximum. It is physically impossible to produce absolutely perfect paper; hence the necessity of using a plurality of "papers" so that weak spots may be scattered between the layers, with ample assurance that there is perfect paper between tinfoil strips at any given point. At least two "papers" should be employed, even in the small by-pass condensers, while more than two "papers" should be included for the higher voltages.

It follows that the safety factor of a paper condenser comes down to the number of "papers." The thickness of the paper cannot make up for the number of "papers," for the reason that defective spots are present in thicker paper just as well as in the thinner paper.

So, pending the establishment of generally accepted standards of practice, the voltage rating on the label of a paper condenser must be interpreted with due discretion.

—HARRY F. HOUCK.

A "Million-Dollar" Front

For Your Receiver

The New

HAMMARLUND

Illuminated

Drum Dial

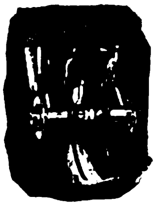
An up-to-the-minute tuning improvement every set-builder will want to install.

FRONT VIEW

HAMMARLUND waited to produce a drum dial that would make the single-control of tuning condensers really practicable.

Local stations can now be tuned in over the entire wave band by the simple movement of two fingers. Distant stations, requiring a finer adjustment, are brought in by a slight realignment of the individual halves of the dial.

Viewed from the front, the new Hammarlund Drum Dial gives to any receiver a delightful, professional finish. The bronze escutcheon plate, richly embossed and oxidized, endows the panel with a classic beauty.



BACK VIEW

Mechanical Features

Over-size die-cast frame; Bakelite drums, with knurled edges; translucent celluloid wavelength scales, illuminated by a small electric light, with handy switch, connecting with the "A" Battery circuit. Adaptable to all standard panel proportions.

HAMMARLUND MANUFACTURING COMPANY
424-438 W. 33rd Street, New York

Already many leading radio designers have officially specified Hammarlund Precision Products for their latest circuits.

For Better Radio
Hammarlund
PRECISION
PRODUCTS

Dealer inquiries invited concerning several other new and appealing Hammarlund developments, having a wide sales appeal.

POPULAR RADIO DEALER AND JOBBER LISTS AVAILABLE TO MANUFACTURERS

The Service Bureau of POPULAR RADIO is able to place at the disposal of radio manufacturers a list of over 21,000 radio dealers, 3,926 radio manufacturers, 1,746 jobbers and 326 manufacturers' representatives. These addresses are immediately available for circularizing prospects for new Fall lines, and more detailed information and rates will be gladly supplied to those who wish to take advantage of what is without doubt one of the most carefully kept lists at present offered for use.

Address all inquiries to:

SERVICE BUREAU
POPULAR RADIO, Inc.
119 West 57th Street New York, N. Y.

What Kind of Voice Has *Your* Loud Speaker?

Does it *Sn-n-arl?* Does it *Whine?*

or Does it register clear, natural *Human* Tones?

The New Muter Clarifier

(Output Transformer)

on your set will astonish and delight you by immediate, almost unbelievable improvement in reception. In nine cases out of ten that weak, distorted voice issuing from the speaker unit is suffering paralysis from high "B" Voltage. The Clarifier protects Speaker coils from this shattering current, assuring longer life as well as strong, full tone, clarity and volume.

If your speaker is one of the great majority that fail to respond properly to the output of the set—you need a Muter Clarifier. It's the only thing that will remedy the cause. Easily attached in a few seconds without disturbing set. Try it out to your own satisfaction on our liberal guarantee—you won't recognize your set!

See Your Dealer—or Send Direct

Dealers can easily secure Muter Products for you from leading Jobbers. If, however, you have any difficulty in obtaining from your dealer, mail coupon direct to us. Prompt shipment will be made upon receipt of price or C. O. D. if preferred. Give your speaker a chance to produce its utmost. Mail coupon today.

Leslie F. Muter Company
76th and Greenwood
Dept. 806-N **CHICAGO, ILL.**

MUTER Dependable Products

The complete Quality Popular Priced Line

Send for comprehensive Catalog

RMA

Use This Coupon!

LESLIE
F. MUTER CO.
76th and Greenwood Ave.
Dept. 806-N Chicago, Ill.

☐ Send Muter Clarified at once, postage prepaid. $5.00 is enclosed. ☐ Send C.O.D.

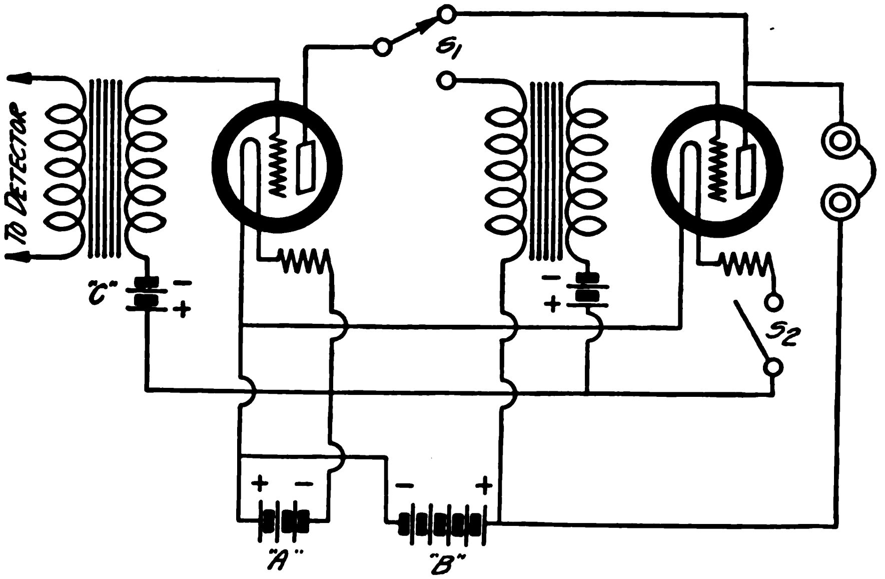
☐ Send complete Muter Catalog.

Name..

Address......................................

City..

State..



A SIMPLE LOUDSPEAKER SWITCHING ARRANGEMENT

FIGURE 7: *By the simple arrangement shown here, the usual loudspeaker jacks are eliminated and the loudspeaker is left connected at all times. Changing over from one stage to another requires only the throwing of the switch S1. The switch S2 cuts off the filament of the last valve when it is not in use.*

Amplifier Switching Scheme

A SIMPLE and inexpensive switching arrangement for changing the loudspeaker from the first to the second audio stage is shown in Figure 7.

The only extra parts that are necessary to add this stage-changing arrangement to the amplifier are a two-point inductance switch and a filament switch for the second audio stage.

The cost of these two switches is not great compared with the cost of filament-control jacks for the amplifier; also, the switches save the constant bother of plugging in the loudspeaker, which is necessary when jacks are used.

With this switching arrangement, the loudspeaker or headphones are left connected all the time to binding posts at the back of the set. When the switch marked S1 is on the lower contact, both audio stages are in operation. When it is on the upper contact, only the first stage is in use, and the filament switch S2 in the second stage should be opened to save the filament of the tube. There is no leakage of "B" battery current in the second tube when the filament switch is open.

This switching scheme is a very simple one to wire up and operate.

—CHARLES F. FELSTEAD, 6-CU

What Magnetic Shielding Means to the Radio Fan

OUT of the present "chaos of the air" has come at least one advance in the radio art—a new line of development in the shielding of radio receivers.

Only a year ago the broadcast listener could "fish" to his heart's content with the simplest of radio sets and bring in distant stations all over the country without interference. Now the best set that one can buy may have difficulty in the reception of stations over a thousand miles away. The tremendous increase in the number of broadcasting stations during the past year demands even better selectivity.

As a rule, the higher the sensitivity of a set, the poorer its selectivity. Adding stages of high-frequency amplification to provide increased sensitivity usually broadens out the tuning so that, when the signals are delivered to detector valve, there are signals from other stations mixed with them.

Many schemes are used to prevent feedback without excessive damping. Setting the inductances at what is known as the "sacred angle" to prevent the fields of the coils interlocking is frequently used, as well as the addition of resistances in the grid circuits or a potentiometer control of the grid bias.

These methods, when carefully applied to a receiver comprising two stages of high-frequency amplification, produce fairly satisfactory results. Another method of attack has just been presented in the Loftin-White circuit, in which the inventors use capacitive as well as inductive coupling between the high-frequency units. It is claimed that this method provides more equal efficiency over the complete wavelength band.

When more than two stages of high-frequency amplification are employed, the problem becomes much more difficult and it is necessary to use magnetic shielding to prevent coupling between the inductances of the set and to prevent the loss in selectivity as the sensitivity is increased.

According to theory, perfect shielding to magnetic fields is almost impossible; yet in practice the proper use of metal shields of certain conductivity provides excellent magnetic shielding. There are several carefully engineered sets on the market in which the shielding produces fine results. The Stromberg-Carlson, for example, is one in which the engineers have taken particular care to make the shielding complete, with copper "cans" entirely surrounding each tuning stage. In some sets, however, metals of too high resistance have been used as the shielding material, or the shielding has been so thin that it has very little effect.

Although the conductivity of the metal is most important, its value is lost if the shields are not designed to enclose properly and completely all the parts affected. An experiment is cited where a set containing three stages of high-frequency amplification, tuned to a powerful station fifty miles away, was enclosed in a copper case inside of an iron case. The cases enclosed the head-set and batteries as well as the receiver proper, so that there was no chance of pick-up from the leads. When a one-inch hole was made through both cases, signals were received with great audibility, and when the lid of the compound case was raised 1/16 inch all the shielding effect disappeared entirely.

An experiment carried out by the author some years ago showed the effect of shielding in no uncertain terms. A sensitive superheterodyne receiver was taken to the cellar of a bank and placed outside the vault, in which location good, audible signals were received. The set was then carried slowly into the vault. At a point just 16 inches inside the threshold of the door the signals ceased abruptly, showing that the set was surrounded by a perfect shield which the field of the transmitting station could not penetrate.

These experiments and others show that inter-stage shielding is in some cases not enough and we may expect a growing tendency to inclose some receivers in completely shielded metal cases of high conductivity.

—ROBERT F. GOWAN

The New UX-240 Detector and Amplifier Valve

THE new UX-240 type valve operates on a 6-volt storage battery and requires the usual rheostat or other provision for reducing this voltage to 5 volts, at a filament current drain of ¼ ampere. It is intended to provide the highest practicable voltage amplification in a resistance-coupled amplifier. This method of amplification, in contrast with the transformer-coupled method, depends entirely upon the vacuum valve for its step-up effect. In transformer coupling, on the other hand, the step-up effect is brought about by the transformer as well as the valve.

The new tube has a ¼-ampere thoriated filament, and is equipped with

ABC
Powerizer

makes every set a De Luxe electric!

Alternating current flows into new A. C. Radiotrons in set. Finest tone quality in radio ∿

NOW you can have any radio set powerized—all ready to plug into light socket. No batteries, jellies, trickle charger eliminator units. Alternating current direct to A. C. Radiotrons in set is the practical, scientific method of electrification.

Deep bass notes—vibrant chords of the organ—are reproduced with the richness and mellowness achieved only by powerized amplification.

Write for literature explaining details of real A B C socket-power and tone quality.

RADIO RECEPTOR CO., Inc.
106 Seventh Ave., New York, N. Y.

LICENSED BY RADIO CORPORATION of America and Associated Companies

Model for Atwater Kent—List without tubes, $60.00. Radiotrons UX-280 and UX-210, $14.00

Radiola "20" Model—List without tubes, $59.00. Radiotrons UX-280 and UX-210. $14.00

Universal Model—for majority of 6-tube R F L and Neutrodyne circuits. Without tubes, $60.00. Radiotrons UX-280 and UX-210, $14.00

Better Results *from* POWER CIRCUITS

Centralab
Power RheostaT

Here are the new Centralab units designed especially for use in socket power circuits to carry continuously an unusually heavy current for their size, providing smooth acting control under all conditions.

Centralab Power Rheostat is warp-proof, heat-proof, permitting continuous operation at temperatures of 482° F. and beyond. Resistance wire is wound on metal core, asbestos insulated. Core expands with wire, insuring smooth action. Narrow resistance strips give small resistance jumps per turn, further insurance of even regulation. Compact 2" diameter, 1" behind panel. Ohms—500, 250, 150, 50, 15, 6, 3, .2, .5—price **$1.25.**

POWER
Centralab
PotentiometeR

This new unit is identical with the Power Rheostat except for an additional terminal, and is especially suited to obtain variable voltages for detector tube and variable "C" bias in socket power circuits. 15, 150, 250 ohms, **$1.50;** 2,000, **$1.75;** 5,000, **$2.00.**

4th TERMINAL
Centralab
PotentiometeR

With an added semi-variable contact arm, this new potentiometer is identical to the above units. The 4th terminal is adjustable behind panel to any resistance value. 175 ohm unit gives 2 variable voltages in ABC power circuits. 250 ohms is used with the new Raytheon ABC. The 2,000 is used for "C" bias in such circuits as Amer-Tran Power Pack. Two 6,000 ohm units in series across output of a "B" eliminator gives best possible voltage regulation. 175, 250 ohms, **$2.00;** 2,000, 3,000, 5,000, **$2.25.**

At your dealer's, or C. O. D. Send for new ABC power circuits and circuits for improved B power control.

Central Radio Laboratories
17 Keefe Ave. Milwaukee, Wisconsin

Centralab CRL

a standard UX-type base. The amplification factor is 30.

The overall amplification of one stage of resistance coupling, employing the UX-240 type valve, is substantially equivalent to the average stage of transformer coupling employing the UX-201-a type valve. This is contrary to the general belief, which holds that resistance-coupled circuits give such poor amplification that an additional stage or two is necessary to produce satisfactory volume. When a general purpose valve of moderate amplification is employed, this is admittedly the case. It may also be the case when valves of a lower "mu" than 30 are employed. However, with the UX-240 type valve in the detector stage as well as in the first stage, there is adequate output to operate a power amplifier at full volume.

The "B" or plate current drawn by the UX-240 type valve is about one-tenth that drawn by the average general purpose tube employed for the same purpose, even when operating at "B" voltages of 135 to 180 volts, which are essential for proper results with resistance-coupling.

The characteristics of the UX-240 type valve are as follows:

Filament Voltage	*5.0 volts*
Filament Current	*.25 ampere*
Maximum Plate Voltage	*180 volts*
Recommended "B" Voltage	*135-180 volts*
Voltage Amplification Factor (mu)	*30*
Plate Resistance	*150,000 ohms*
Plate Current at Rated Voltages,	*.2 milliampere*

When employed in resistance-coupled amplification, the UX-240 type valve should have a negative grid bias, which may be obtained from a "C" battery, to ensure freedom from distortion. Only the highest grade blocking condensers and resistances should be employed. The condensers must have high insulation resistance, while the resistances must be capable of withstanding the necessary current flow without deterioration. Otherwise, noisy reception may result sooner or later. The UX-240 type valve is non-microphonic and otherwise free from noises.

—J. L. BERNARD

More Data on the Retrosonic Receiver

NUMEROUS inquiries have been received from readers of POPULAR RADIO for further enlightenment regarding the specifications of the coils and the values of the parts used in the Retrosonic Receiver which was described by Mr. A. Dinsdale in the March, 1927, issue.

Here is this information. The reader is cautioned, however, before proceeding to construct this set, to realize that this is a freak circuit and the results that the designer obtained cannot be had without experimenting. The receiver described in the March issue was made up entirely of British parts and the substitution of American material might make the circuit act differently. It might be necessary to apply "cut and try" methods to get success.

Figure 8 gives the schematic circuit. Here are the specifications of the coils used:

Coil No. 5—64 turns of No. 24 DCC wire. Starting at the ground end, tap off at ten successive points, consisting of approximately 4 turns each.

Coil No. 9—64 turns of No. 24 DCC wire.

Coil No. 11—89 turns of No. 28 DCC wire.

The author's information in regard to Coil No. 12 is that it consists of 89 turns of No. 28 DCC wire. In experimenting this tickler coil may have to be cut down to as low as 30 turns.

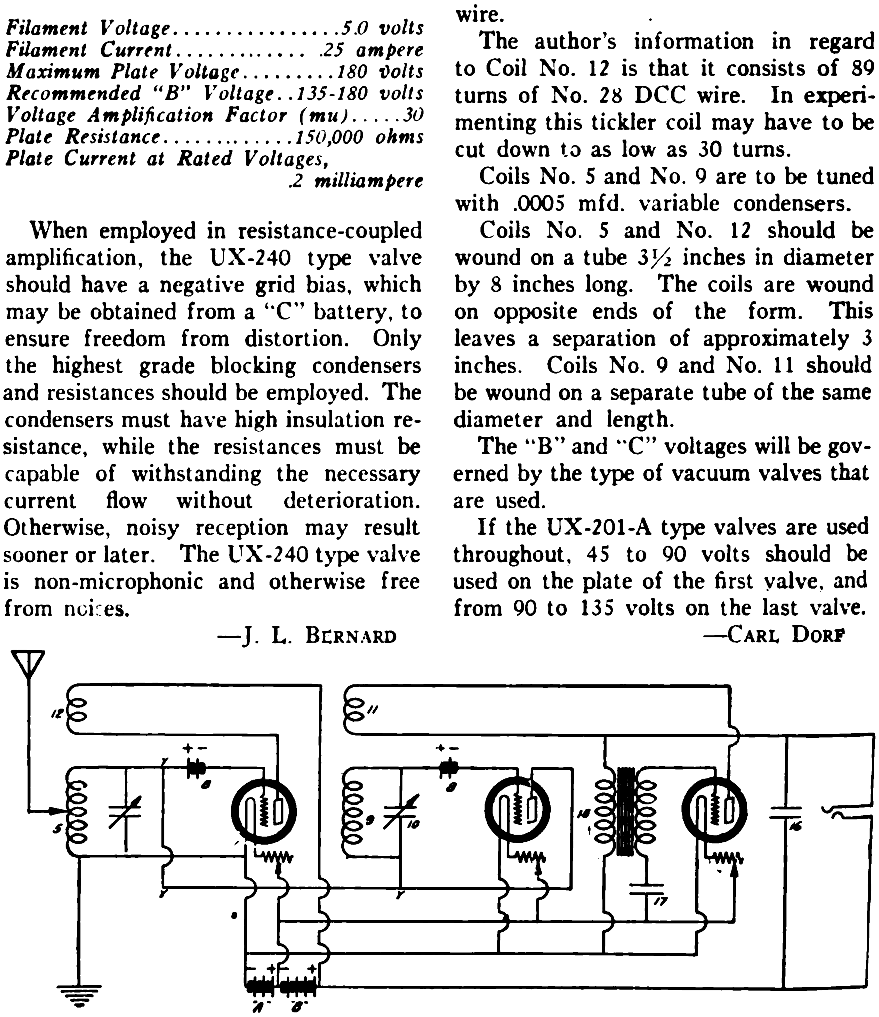
Coils No. 5 and No. 9 are to be tuned with .0005 mfd. variable condensers.

Coils No. 5 and No. 12 should be wound on a tube 3½ inches in diameter by 8 inches long. The coils are wound on opposite ends of the form. This leaves a separation of approximately 3 inches. Coils No. 9 and No. 11 should be wound on a separate tube of the same diameter and length.

The "B" and "C" voltages will be governed by the type of vacuum valves that are used.

If the UX-201-A type valves are used throughout, 45 to 90 volts should be used on the plate of the first valve, and from 90 to 135 volts on the last valve.

—CARL DORF



THE BRITISH "RETROSONIC" CIRCUIT THAT HAS AROUSED UNUSUAL INTEREST

FIGURE 8: *This circuit was originally described on page 246 of the March issue of* POPULAR RADIO. *For the convenience of experimenters who are interested, the circuit specifications are given above.*

More than 1,000,000 owners of General Electric Battery Chargers *now have peppy radio batteries – always*

New Low Prices
(East of the Rockies)

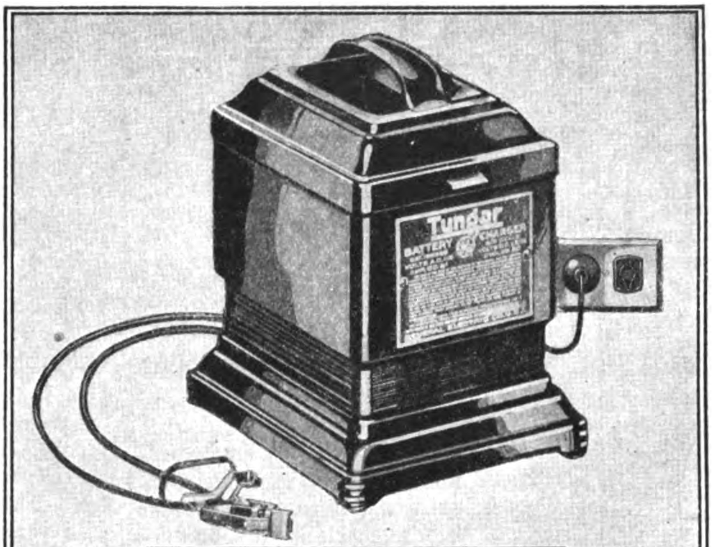
2-ampere Tungar, now $14
5-ampere Tungar, now $24
G-E Trickle Charger, now $10

Tungar causes no radio interference. It cannot blow out tubes.

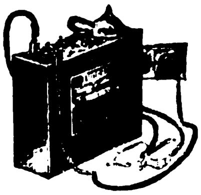
An overnight charge costs about a dime

It is a G E product developed in the Research Laboratories of General Electric.

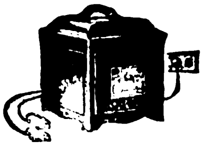
The 2 or 5-ampere Tungars charge 2-, 4-, and 6-volt "A" batteries, 24- to 96-volt "B" batteries in series; and auto batteries, too. No extra attachments needed.



$10. $24. $14.



Trickle Charger



5-ampere Tungar

Keep your radio set ready—at all times—for all the good things that come over.

Just turn on Tungar (the name of the General Electric battery charger) at night, leave it as you would the light in the hall . . . . in the morning your storage batteries are pepped up and ready for active duty.

More than a million G-E Tungars are in use today. For the Tungar long ago established its reputation for dependable, trouble-free, economical service.

Your dealer can help you. Ask him to show you the popular 2-ampere Tungar that gives both trickle and boost charging rates. It charges "A" and "B" radio batteries and auto batteries, too.

GE Tungar
REG. U.S. PAT. OFF.
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

Merchandise Department
General Electric Company
Bridgeport, Connecticut

GENERAL ELECTRIC

Townsend
"B" Socket Power
"Best in World!"
Says A. W. GALE
of Gloversville, N. Y.

Only $6.85 COMPLETE $1.00 Down Balance C.O.D.

Below is a reproduction of Mr. Gale's letter of May 8th, 1927.

48 W. Fulton St.,
Gloversville, N. Y.

"Received the Townsend all O. K. *It is the best in the World and that is saying some.* I have a Radiola 4 tube. Get more stations than ever before. Some of them are CFCF, CKNC, WGY, KDKA, WGZ, WIP, WWJ, KTHS, KOP, KOA, WHAS, WTAM and KSD—besides 4 in Chicago, all in the East and then some."
A. W. Gale.

Replaces "B" Batteries

The letter above speaks for itself—proves beyond doubt that the Townsend "B" Socket Power is the most remarkable value in Radio today. Sam E. Fry of 1415 Holmes St., Kansas City, Mo., writes: "Eliminator works fine. Showed it to a friend and he wants one also. I will say it sure beats batteries. I get stations I never got before on a 6 tube set." Charles Ellis, 88 Jones Ave., Columbus, Ohio, says, "Your Eliminator is working fine. Have had station WJAX and others over 1,000 miles distant. Picked up 22 different stations one evening and around 30 another time. My neighbor has a $27.50 Eliminator and I don't see that it works any better than yours."

Delivers up to 100 volts on any set, on D. C. or A. C.—any cycle. Full tone, clarity and volume.

Tested and approved by America's leading Radio authorities—Radio News and Popular Radio Laboratories

ORDER TODAY!

Simply fill out the coupon and slip it into an envelope with only $1.00 and mail at once. Your Townsend "B" Socket Power Unit will be sent promptly. Deposit only $5.85 plus postage with the postman. Try out for 10 days—then if not delighted with improvement in reception, return it to us and purchase price will be refunded.

TOWNSEND LABORATORIES
713 Townsend St., Dept. 19, Chicago, Ill.

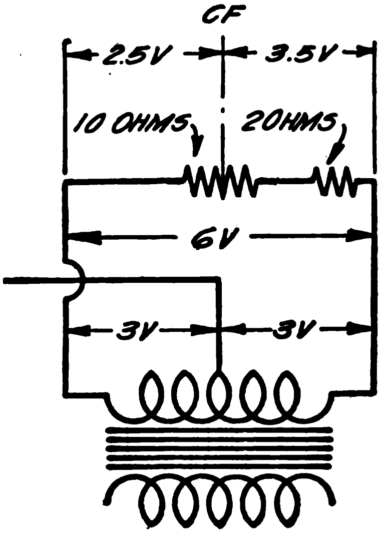
Attach Only $1.00 to this Coupon!
SEND TODAY

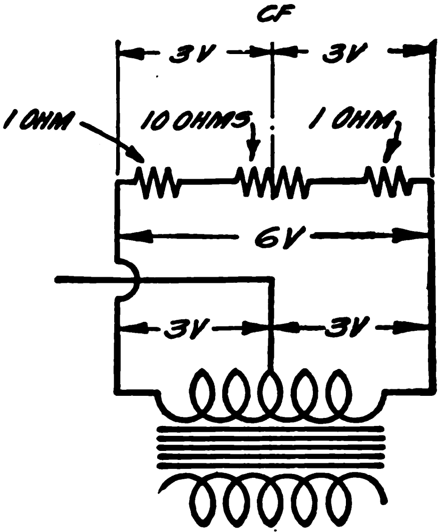
10 Days FREE TRIAL You are the Judge!

TOWNSEND LABORATORIES
713 Townsend St.
Dept. 19, Chicago, Ill

Gentlemen: Attached find $1.00. Kindly send at once Townsend "B" Socket Power Unit, C. O. D., for $5.85, plus postage, on guaranteed 10-day free trial.

Name..
Address..
City.............................*State*..............





THE WRONG AND RIGHT METHODS OF REDUCING AC FILAMENT SUPPLY VOLTAGE

FIGURE 9: *The use of a rheostat in one leg of the filament circuit unbalances the voltage distribution in the filament and causes a varying relation between filament and grid—which results in a hum.*

FIGURE 10: *With a rheostat in each leg of the filament, the proper voltage relation is maintained, and the center point of the filament is likewise the voltage center and therefore a neutral point.*

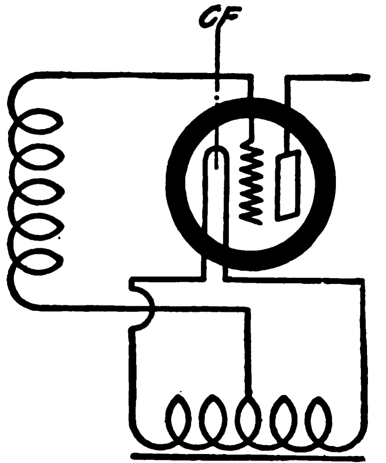
A Pointer on AC Filament Supply

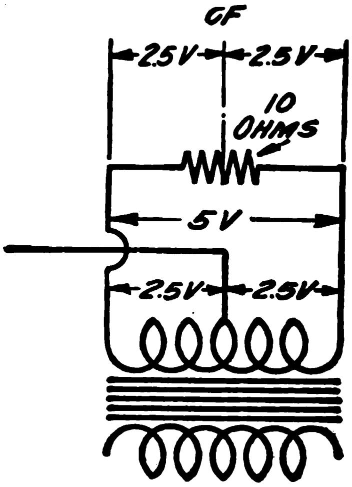
WITH the average "B" power-pack there is little to worry about in fluctuating AC line voltage unless the variation is extreme. Even if the line voltage varies as much as 10 volts during the day the increase or decrease in the output voltages of the "B" power-pack will be unimportant, because these voltages are not critical.

However, if the filament of one or more valves are operated from the AC line through a transformer, line variations may considerably shorten the life of these filaments. For instance, if the line voltage is 10 per cent above normal, there will be a correspondingly high voltage applied to the filaments.

If it is desired to regulate the output voltage of the transformer which supplies the filament or filaments, the logical place to control it is in the line side. This is accomplished by the use of a variable resistance in series with the primary of the transformer as shown in Figure 13. For this use an ordinary rheostat will not do, but there are now a number of heavy duty primary rheostats on the market that are intended for this purpose.

Another method is to make use of variable resistances in series with the filaments of the valves that are operated on the AC lines. This method is less desirable, because for proper results it is

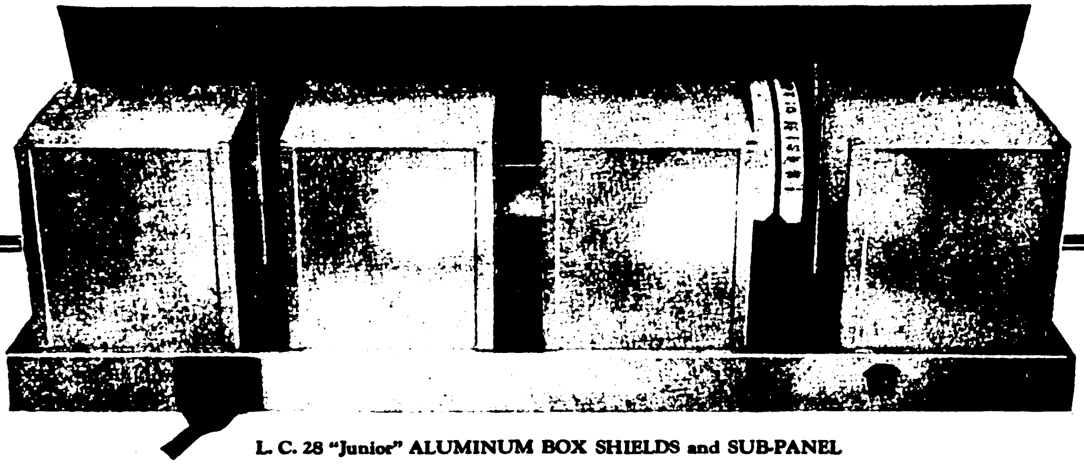




THE CIRCUIT AND SCHEMATIC DIAGRAMS OF AN AC FILAMENT SUPPLY CIRCUIT

FIGURE 11: *The components of an AC filament supply circuit are indicated diagramatically above in order to make clear the schematic diagram of Figure 12. Note the center-tapped transformer secondary used for grid supply.*

FIGURE 12: *For simplicity the filament in Figure 11 is represented above as a resistance and the other elements are omitted. The numbers represent the voltage drops in the various parts of the filament circuit.*



L. C. 28 "Junior" ALUMINUM BOX SHIELDS and SUB-PANEL

ALUMINUM

at the Radio Shows

This year's Radio Shows indicate that Aluminum has been adopted for shielding by more of the leading manufacturers and Radio Engineers than ever before.

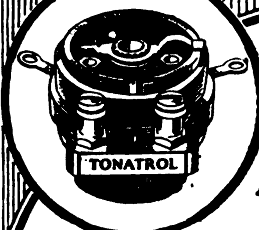
Mr. L. M. Cockaday's L. C. 28 is an outstanding example of the use of Aluminum in prominent sets. L. C. 28 specifications call for an Aluminum Sub-panel, Aluminum Box Shields and Aluminum front panel with grained finish.

The box shields designed especially for this set are adaptable to many hook-ups. They are known as "Junior" ALUMINUM BOX SHIELDS.

See this set at the show and visit the Aluminum Booth B. B. 5 in New York and C. C. 1 in Chicago.

ALUMINUM COMPANY OF AMERICA
2461 Oliver Building, Pittsburgh, Pa.
Offices in 18 Principal American Cities

ALUMINUM IN EVERY COMMERCIAL FORM



Exclusively Licensed by Technidyne Corporation Under U. S. Patent No. 1593658, July 27, 1926.

MUSIC, Soft or Powerful

Which Do You Like?

"TONATROL"

A True Tone and Volume Control

"TONATROL" is as superior to ordinary volume controls as the auto is to the "bike." Enables you to turn from sweet, far-away music to soul-filling volume in a jiffy. Any shade of tone always at your command.

Made with genuine Bakelite. Tonatrol is a real addition to any set. Very easy to install. Your dealer has "TONATROL"—ask him.

Tonatrol—Standard Volume Control $1.50

Tonatrol—Type W.S. (with filament switch attached), $2.00

Write for free installation booklet for the correct way to control volume.

Dept. 43B, 175 Varick St., New York, N. Y.

ELECTRAD Inc

The
POPULAR RADIO
Atlas *and* Log

will give you a list of all the NEW Broadcasting Stations with wavelengths and other necessary information

A Complete Atlas and Station Log

The "Popular Radio International Radio Atlas and Log" will supply you with full information regarding broadcasting stations of the United States and Canada.

This most useful and practical Atlas consists of 16 pages, size 12" x 15", printed on good paper, from clear type in two colors and contains a complete series of double page maps, including—The World—The United States—Canada—North and South America, showing location of principal broadcasting, leading commercial and governmental radio stations.

SPECIAL FREE OFFER

You may have a copy of the "Popular Radio International Radio Atlas and Log" free, with Popular Radio for (8) eight months

For Only $2.00

Pin $2.00 in bills to the coupon below.

If you are a subscriber to Popular Radio your subscription will be extended eight months.

Date.............

Popular Radio, Dept. 42A,
119 West 57th St., New York City.

Enclosed is my remittance of $2.00 for which you are to enter my subscription (extend my subscription) for (8) eight months for Popular Radio and send FREE a copy of the "Popular Radio International Radio Atlas and Log."

Name...

Address...

City.................................State.............

ALL
POPULAR
CIRCUITS

Described in Popular Radio and other leading magazines and newspapers will be found in Newark's new Kit Supplement.

Set builders will find in this new Newark directory of kits, itemized lists of parts used in all the new circuits.

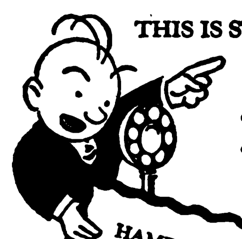
Newark's central location near the center of population makes it possible to serve the greatest part of the country in the least time.

Large stocks of all popular merchandise is always on hand and orders are filled at once.

Send ten cents in stamps to cover mailing and handling charges for this new kit supplement.

Dealers ask about discounts

NEWARK ELECTRIC CO
"Nothing but Radio"
226 WEST MADISON STREET
CHICAGO
ILLINOIS



THIS IS STATION "HAMPTON-WRIGHT", INDIANAPOLIS

Announcing—

BARGAINS in RADIO

FOR SET BUILDERS,
DEALERS AND FANS

HAMPTON-WRIGHT,
138 Darmody Bldg., Indianapolis, Ind.

Dear Sirs: Tune me in on these Hampton-Wright radio bargains. Send a copy of your new catalog today to:

Name________ Address________

City________ State________

Mail this coupon TODAY

"The Book of a Thousand Radio Bargains," the new Hampton-Wright catalog, is filled with parts and accessories made by the best known manufacturers, offered at sensationally low prices. You should have this catalog. Mail the coupon today.

HAMPTON-WRIGHT
RADIO PARTS AND ACCESSORIES
DARMODY BUILDING ✣ ✣ ✣ INDIANAPOLIS

G.R.PENN'S NEWEST

Only speaker designed by and now being made under G. R. PENN'S Direct Supervision

G·R·P
3-FOOT
Cone Speaker
"Assemble It Yourself"

ABSOLUTELY NEW!

—quicker, easier way to build a better 3-ft. Double Cone Speaker

A finer speaker than you thought possible—truest reproduction, finer tone quality, greater sensitivity and ability to reproduce a wider range of frequencies, high and low, than speakers have had heretofore...Can be compared only with very high priced speakers.

Assembled Flat!
G. R. Penn's latest invention lets you assemble this speaker FLAT. Cones shape themselves. Success certain. Anyone—even if you never have built anything—can assemble a perfect G.R.P. 3-foot Cone Speaker. Illustrated, easily understood Assembling Instructions.

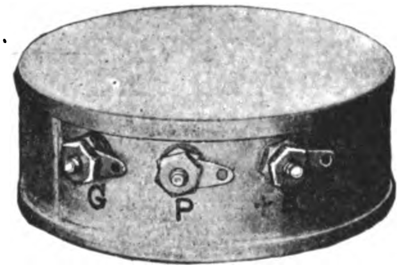
At Reliable Dealers
Ask your dealer for G.R.P. 3-foot Cone Speaker Kit—the Double Cone for $13.50 or the Single for $10.50. If he hasn't them, and will not get them for you, refuse imitations; we will supply you direct, f.o.b. N. Y. C., on receipt of price.

G. R. P. 3-foot Double Cone Kit
Complete in every detail—absolutely nothing else to buy; decorated, marked genuine Fonotex; G.R.P. Unit, G.R.P. Back Ring (pat. pend.) Ambroid, Unit Mountings, braid, etc., etc. *Complete!* in one package $13.50

G. R. P. 3-foot Single Cone Kit
Finest Single Cone Speaker you can build; complete in every detail with unit and wall frame $10.50

"How to Build Seven Practical 3-foot Speakers", price 50c. For a limited time sent for 10c, coin or stamps. Write today.

G.R.P. PRODUCTS CO., INC.
104 Fifth Ave. Suite 2399 New York City



Shielded Tuned Radio Transformer, No. 30

SICKLES

Diamond-Weave Coils

The new Sickles Shielded Tuned Radio Transformer prevents both outside and local interference. It is remarkably compact, sharp-tuning, sturdy.

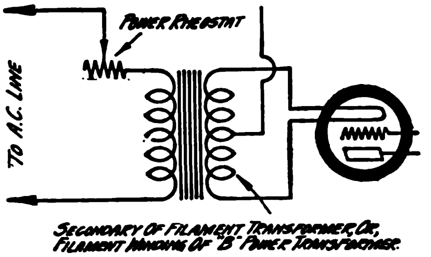
Sickles Diamond-Weave Coils have established an enviable reputation for low distributed capacity, low dielectric losses, and large range of frequency with small variable capacity.

The Ideal coil for the Na-Ald Localized Control Tuning Unit and the Na-Ald Truphonic Assembly.

There are Sickles Diamond-Weave Coils for all leading circuits.

THE F. W. SICKLES CO.
134 UNION STREET
SPRINGFIELD :: MASS.

No.	Coil Prices	
30	Shielded Transformer	$2.00 each
24	Browning-Drake	7.50 set
18A	Roberts Circuit	8.00 set
25	Aristocrat Circuit	8.00 set


POWER RHEOSTAT
TO A.C. LINE
SECONDARY OF FILAMENT TRANSFORMER, OR, FILAMENT WINDING OF "B" POWER TRANSFORMER.

ANOTHER METHOD OF REGULATING AC FILAMENT SUPPLY

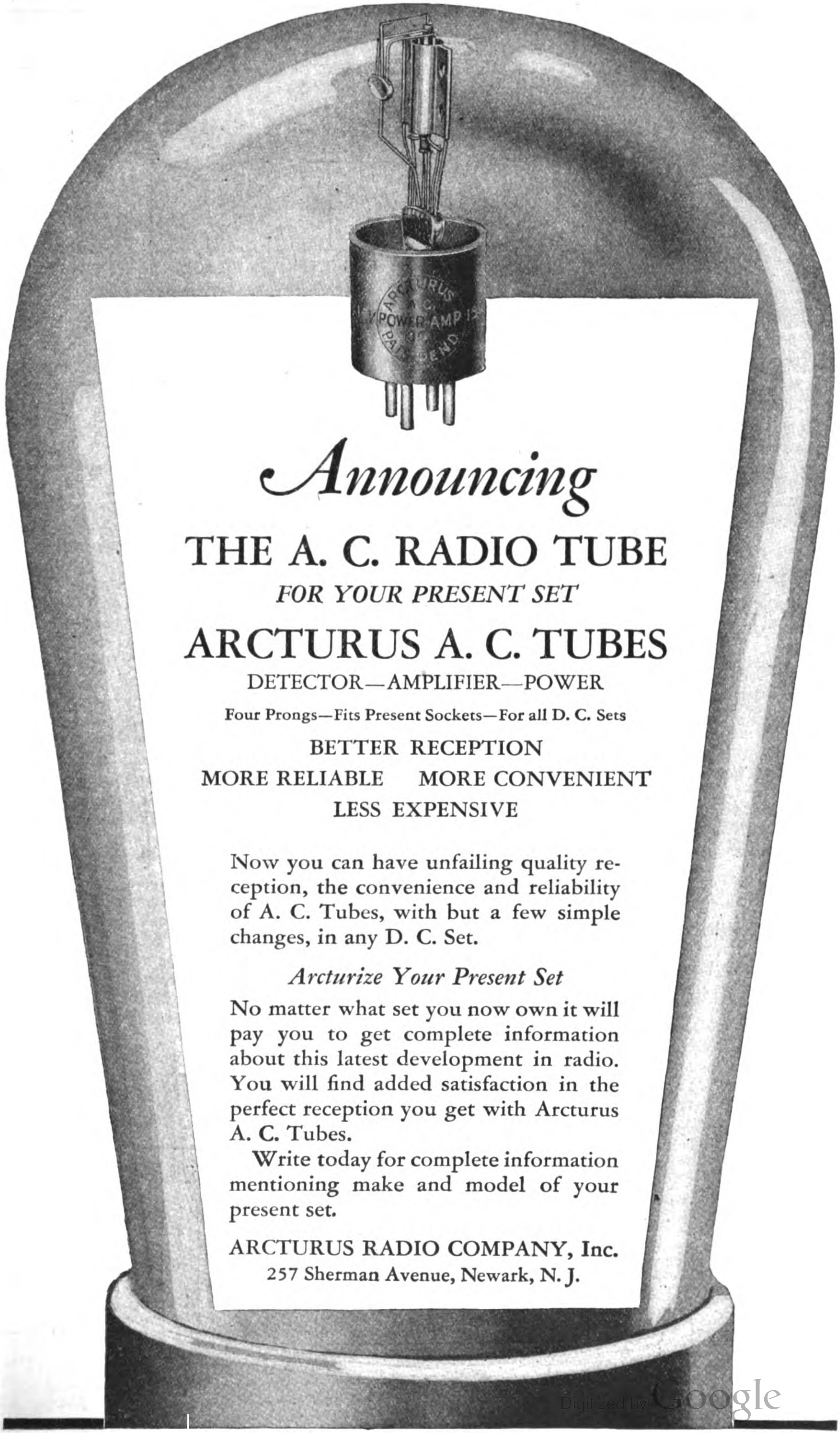
Figure 13: *A power rheostat in the AC line supply probably gives the surest results in regulating the amount of AC filament supply current.*

necessary to use a rheostat in each side of the filament and to keep the resistance of the two rheostats equal. Such an arrangement is shown in Figure 10. If a single rheostat is used it will in effect apply a varying voltage relation between the filament and grid, with the result that there will be a hum in the valve output as explained in Figure 9.

Figure 11 shows the usual connections of the filament and grid where the filament current is supplied with alternating current from a center-tapped transformer winding. Figure 12 shows this in schematic form with the grid omitted and the filament shown in the form of a resistance. For purpose of illustration this can be considered to represent the filament of a 171 type power valve, in which case the filament resistance is 10 ohms.

In operation the direction of current flow reverses 120 times a second, which means that the right-hand end of the 5-volt transformer winding and the right-hand end of the resistance will be alternately positive and negative with each reversal of the current. The center tap of the transformer winding must be kept neutral, and also the center of the filament (CF).

In Figure 9 is shown the same arrangement, but with a rheostat, R2, in one leg of the filament circuit. Assume that the transformer output is 6 volts and that it is necessary to cut this down to 5 volts for the 171 type of filament. A series resistance of 2 ohms (R2) will be necessary to accomplish this. Now there is a voltage drop of 5 volts across the filament R1 and of 1 volt across the resistance R2. Therefore, the center of the filament is no longer the neutral point, as it is not the center of the total resistance, and therefore cannot be the voltage center. The result therefore is that at one instant the center of the filament will be ½ volt positive in relation to the actual voltage center point and on the other half of the cycle will be ½ volt negative. Inasmuch as the grid remains always at the voltage center point, it is evident that the filament will be alternately positive and negative in its relation to the grid, thus causing a hum.



Announcing

THE A. C. RADIO TUBE

FOR YOUR PRESENT SET

ARCTURUS A. C. TUBES

DETECTOR—AMPLIFIER—POWER

Four Prongs—Fits Present Sockets—For all D. C. Sets

BETTER RECEPTION
MORE RELIABLE MORE CONVENIENT
LESS EXPENSIVE

Now you can have unfailing quality reception, the convenience and reliability of A. C. Tubes, with but a few simple changes, in any D. C. Set.

Arcturize Your Present Set

No matter what set you now own it will pay you to get complete information about this latest development in radio. You will find added satisfaction in the perfect reception you get with Arcturus A. C. Tubes.

Write today for complete information mentioning make and model of your present set.

ARCTURUS RADIO COMPANY, Inc.
257 Sherman Avenue, Newark, N. J.

You Will Marvel at the Tone Reproduction of the

Temple Drum Speaker

(Long Compensated Air Column)

People are positively astonished when they hear the TEMPLE SPEAKER for the first time. The marvelous clarity and purity of tone is amazing.

The TEMPLE SPEAKER brings new joy in radio. Thruout the entire musical scale this super-speaker is sensitive beyond comparison—unequalled for tone quality. Dance music—organ recitals—opera—hear them now in a way you never dreamed was possible!

Not a Cone

Regardless of the kind of radio set you operate, the TEMPLE SPEAKER will greatly improve its reception due to its long compensated exponential air column Temple construction. The best set made will not give satisfactory results unless accompanied by the *right speaker.*

Test the TEMPLE by comparison. Any Temple Dealer will be glad to give you a home demonstration with a Temple *comparator.*

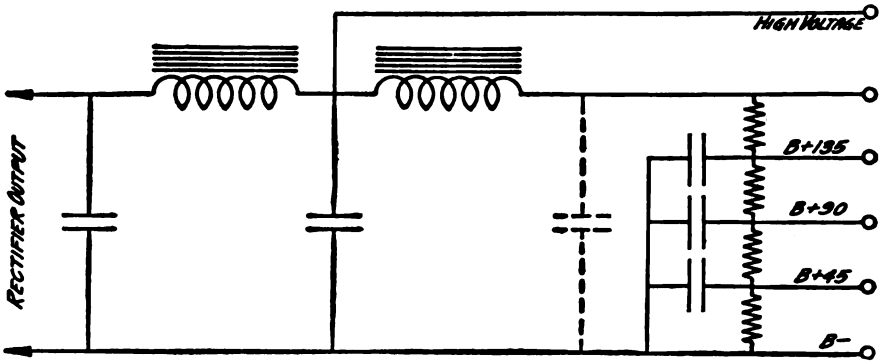
CONSOLE CABINET MODEL No. 65—priced at $65.00; west of Rockies, $75.00

DRUM TYPE MODEL No. 13—13 inch—priced at $29.00; west of Rockies, $32.00

DRUM TYPE MODEL No. 18—18 inch—priced at $48.50; west of Rockies, $55.00

If your dealer cannot supply you write for complete information and name of our nearest Temple dealer

TEMPLE, Inc.
213 S. Peoria St., Chicago, Ill.
LEADERS IN SPEAKER DESIGN



AN IMPROVED FILTER THAT PRODUCES LESS HUM

FIGURE 14: *This circuit is particularly adapted to power-packs that use the UX-216-b type of rectifier valve. The condenser shown by the broken line may be dispensed with entirely or it may be shunted across the middle condenser to furnish greater capacity at that point.*

Reducing the Hum in "B" Power-Packs

THERE are some "B" power-packs in use which, although they are constructed of the finest parts, produce quite a hum in the reproducer when connected to a receiver. Usually this hum is not audible while signals are tuned in, but it does become noticeable during the quiet intervals between announcements at the broadcast station.

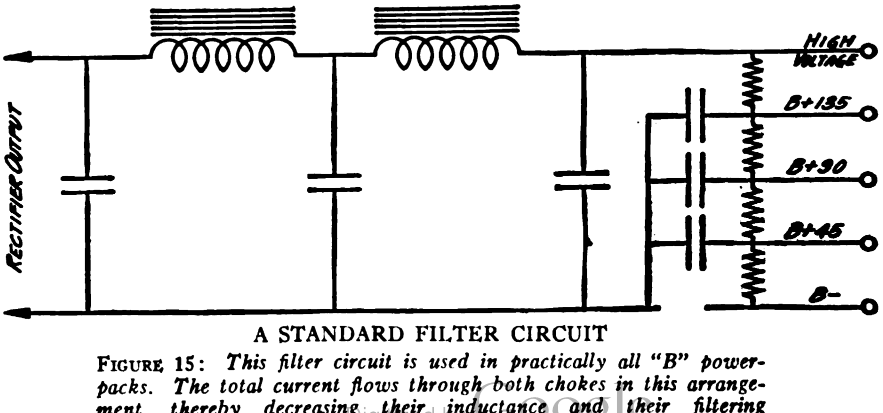
In experimenting with "B" power-packs of various types in which instruments of known quality were used, some interesting things were brought to light. Four distinct causes for hum were found and eliminated without any additional expenditure for extra equipment.

If the power-pack is placed close to the receiver with which it is used, it is possible to obtain a hum as a result of the electromagnetic coupling between the power transformer in the power-pack and the low-frequency transformers in the receiver—particularly the transformer in the first low-frequency stage.

To eliminate this source of trouble it is not always necessary to move the power-pack farther from the receiver. Moving the power-pack only a few inches one way or the other may do the trick, or it can sometimes be accomplished by turning the power-pack around at an angle of 90 to 180 degrees from its original position. If the power-pack is located in the battery compartment of a console, with the receiver on top, undesirable coupling can sometimes be eliminated by placing the power-pack at the opposite end of the console from its normal position.

Where a power-pack includes an automatic relay switch, this instrument may cause a considerable hum if it is too close to the power transformer. One power-pack tested produced a decidedly loud hum that could be heard twenty feet away from the loudspeaker when the set was in operation. In this the relay switch was placed within one-half inch of the power transformer. By removing the relay from the power-pack and placing it a foot away from the power transformer the hum was reduced to a point where it was scarcely audible. The hum from this cause results from electromagnetic coupling between the power transformer and the magnet windings in the relay and will disappear when this coupling is reduced.

Sometimes the relay need not be close to the transformer to cause this hum. In some cases the transformer field seems to follow along any extensive metal path provided for it, such as, for instance, the walls of the cans which inclose the filter condensers. To determine the best position for the relay it is well to unfasten the relay and move it around while the power-pack and receiver are in operation.



A STANDARD FILTER CIRCUIT

FIGURE 15: *This filter circuit is used in practically all "B" power-packs. The total current flows through both chokes in this arrangement, thereby decreasing their inductance and their filtering efficiency. Figure 1 shows an improved circuit.*

In cases where the current drawn from the power-pack is high, a reduction of hum can sometimes be obtained by taking the high voltage tap off between the chokes, as shown in Figure 14, instead of from the output side of the second choke, as shown in Figure 15. Less filtering action is neccessary in the case of the high voltage used to supply the plate of the last low-frequency valve, and there is no need of more than one choke and its attendant condensers to procure adequate filtration. The plate voltage for the other valves requires a higher degree of filtration, and therefore needs the two chokes, although the last filter condenser, indicated by a dotted line in Figure 14, may be eliminated.

By taking the high voltage tap off between the chokes the current drawn from this tap does not flow through the second choke at all. The inductance of a choke increases with a decrease of current flowing through it. If the comparatively high current drawn by the plate circuit of a power-amplifier valve in the last low-frequency stage is removed from the windings of the second choke the inductance of the choke is therefore increased and the filtering action on the current that passes through this choke is increased. The result of this change is to provide better filtering action on the "B" voltage supply for the circuits that are more susceptible to hum, and at the same time to provide adequate filtering action for the circuit of the last amplifier valve.

A fourth thing that sometimes causes a hum in a "B" power-pack which also supplies the "C" bias for a power-amplifier valve, is the improper adjustment of the "C" voltage. Improper adjustment of the "C" voltage control of the power-pack may permit excessive current to flow in the plate circuit of the power-amplifier valve, with the result that the power-pack is called upon to supply more current than its filter can properly handle. By adjusting the control to provide a higher "C" voltage the current drawn from the power-pack may be reduced to a normal value.

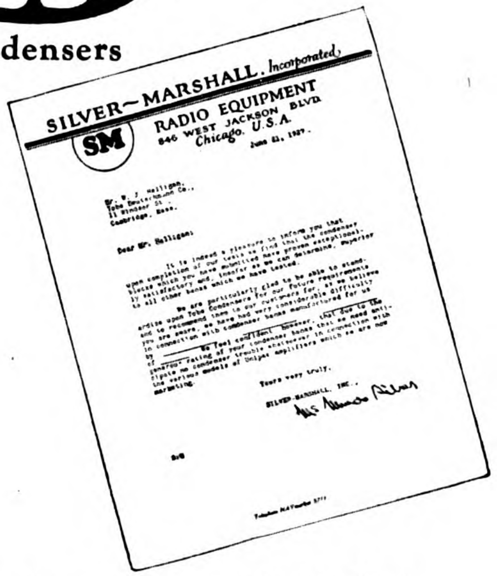
Most fans do not have the proper voltmeters on hand to permit them to adjust the "C" bias voltage by actual figures. As a matter of fact, this adjustment may often be made by ear. While the receiver is in operation at full volume the "C" voltage control should be varied until the sweetest and clearest reproduction is obtained. Many are under the impression that the "C" adjustment is correct when the greatest volume of reproduction is obtained. This idea is not necessarily correct; and in many cases judging the "C" battery adjustment by the volume of reproduction alone may be the cause of operating with too low a "C" voltage, with a resulting excessive plate current drain.

—S. GORDON TAYLOR

TOBE

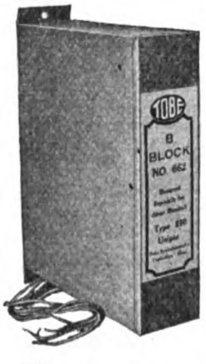
"Superior to all others tested"

Condensers



SILVER~MARSHALL, Incorporated

RADIO EQUIPMENT
846 WEST JACKSON BLVD
Chicago, U.S.A.



Recognized radio engineers have for a long time known the excellence of Tobe Condensers. They have the quality of continuing to function perfectly over long periods of time. Now the Tobe No. 662 high voltage B Block has been selected exclusively by McMurdo Silver for use with the new Silver-Marshall UNIPAC and Mr. Silver has written us the above reproduced letter. Send for price list L-10.

Tobe Deutschmann Co.

Cambridge - - Mass.

ALL THAT'S NEWEST IN RADIO GOODS

with better service, quicker shipments and lower prices that give you, as a retailer tremendous advantages over your competitors. Write at once for the

Greatest Catalog

of Radio Goods, Sets, Kits and Parts—GET YOURS!

No order too small—none too large to receive painstaking attention. Check the prices in this wonderful book with invoices you are paying.

Note: We sell only to radio retailers. Write today!

The Harry Alter Co.

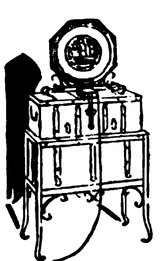
1764 Michigan Avenue CHICAGO

AT LAST! Control of Radio Reception from Your Easy Chair!

Turn set *on* and *off*—get station after station—swiftly—surely—DX—without leaving your easy chair.

The NEW *Algonquin*

Remote Control Radio Tuning Unit



No other tuning unit in the world like it. Tune your set from any room of your home. Attached to any single dial receiver with removable dial in a few minutes by removing old dial and attaching adapter plate with Remote Control Unit.

10% West of Rocky Mts.

Mechanical Model	**$18.00**
Electrical Model	**$60.00**

Write today for circular describing radio's newest and most revolutionary development

ALGONQUIN ELECTRIC COMPANY, Inc.
Leo Potter, President
245 Fifth Avenue, New York City

INSIST

AMPERITE is the only automatic filament control that keeps the temperature or voltage of the tube filament constant despite variations in the "A" battery voltage. It guarantees improved tube performance and increased tube life through always operating tubes at their proper filament temperature. Simplifies wiring, panel design, tube control, tuning. Eliminates hand rheostats. Do not confuse with fixed filament resistors which attempt to imitate AMPERITE but are entirely different in principle and operation. Insist upon *Amperite.* Price $1.10 mounted (in U.S.A.) For sale by all dealers.

***Write for FREE "Amperite Book" of season's best circuits and latest construction data. Address Dept.* PR10**

Radiall Company
50 FRANKLIN ST., NEW YORK

AMPERITE
REG. U.S. PAT. OFF.
The "SELF-ADJUSTING" Rheostat

RADIO CATALOG *free*

2000 Exceptional Radio Values

1928 WHOLESALE CATALOG of RADIO Sets, Kits and Everything in Radio

LOWEST PRICES to DEALERS

Every Set Builder Needs This Book

Make This a Big Radio Season!

Every live dealer in radio sets, parts, accessories, supplies, etc., should have a copy of this bargain catalog. You will be amazed at the thousands of money-saving radio items illustrated and listed in this storehouse of everything you could possibly need in radio.

The GUIDE BOOK to Bigger RADIO PROFITS FOR YOU

The book contains all the latest and most popular kits--all the famous, nationally known radio parts, accessories and supplies – the very newest types and designs of table cabinets and consoles – everything at prices that mean bigger profits for you.

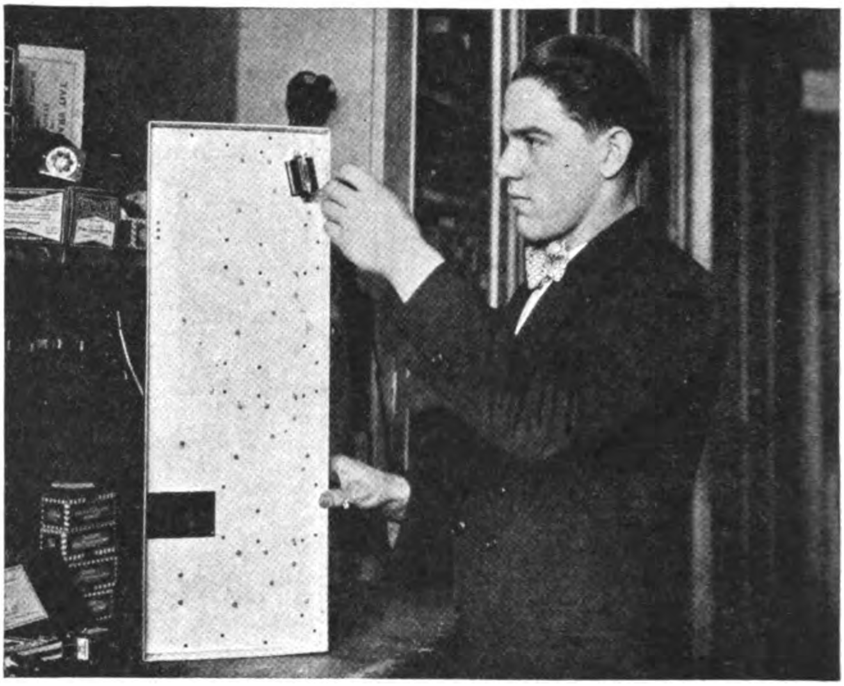
Short Wave Section Our catalog contains a section devoted to a showing of the highest grade short wave receiving and transmitting apparatus. Also the finest electrical appliances for use in the home.

Dealers Make More Money! Tie up with a house that carries large, complete stocks, that gives you the highest quality radio parts, that insures speedy shipments and 100% satisfactory service. Our wholesale vest pocket price list and discount sheet and catalog will be sent to you on request.

BUT WRITE QUICKLY
SHURE RADIO COMPANY
337E West Madison Street Chicago, Illinois

How To Build The LC-28 Receiver

(Continued from page 217)



From a photograph made for POPULAR RADIO

A SCREW-DRIVER DOES THE ASSEMBLING

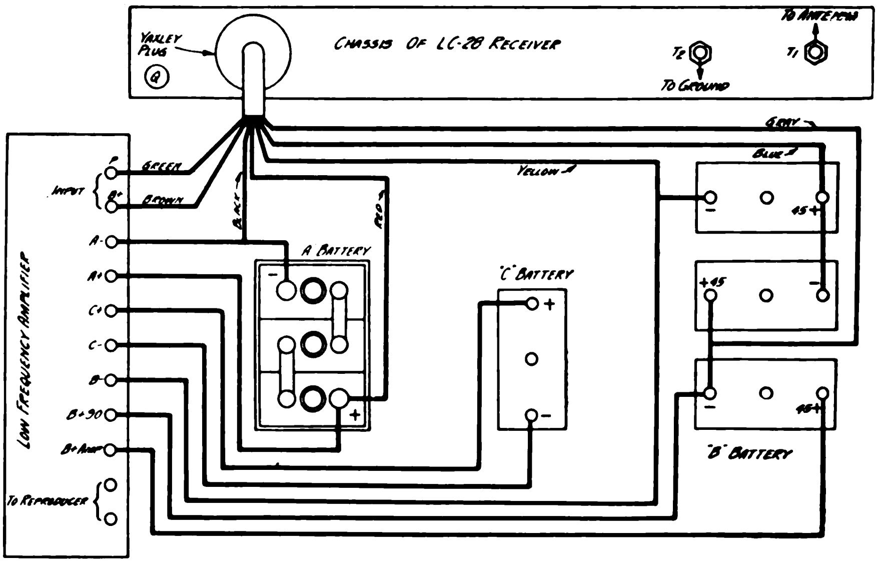
FIGURE 8: *The mounting holes in the drilled chassis exactly accommodate the instruments specified on page 214, and the mounting requires nothing but a screw-driver and a small socket wrench to fit the nuts, which are all of one size, 6/32.*

in Figure 3 for the exact connections that should be made. This carries out the theoretical circuit shown in Figure 5.

The best scheme is to start by wiring up the connections on the bottom side of the chassis, Y. This includes the connections on the chokes, E1, E2, E3 and F, and the fixed condensers, K1, K2, K3 and M, located under the chassis, as well as the connections to the Yaxley plug, Q. Following this the connections to the combination variable resistor and switch, S, and the wiring to the positive filament terminals of the sockets, P1, P2, P3 and P4, should be made.

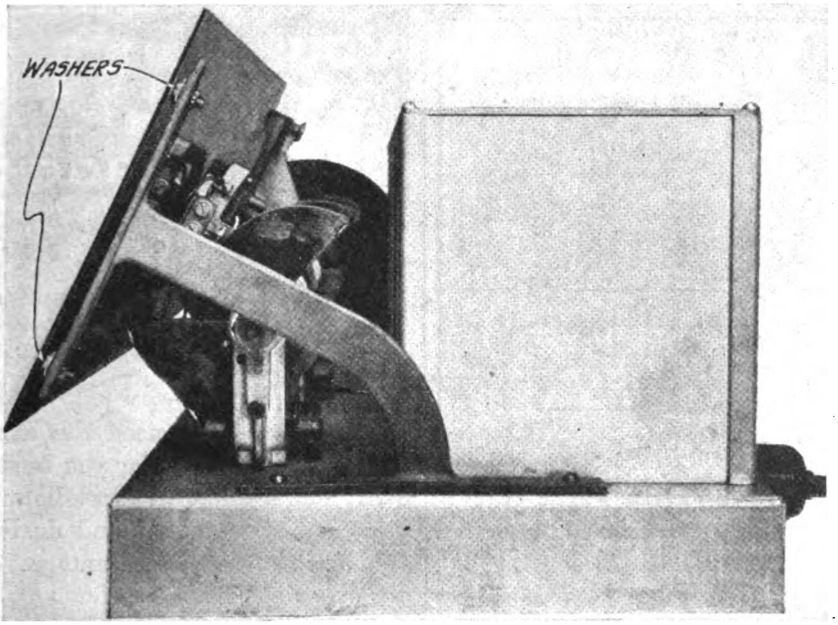
Next, complete the connections between the terminals marked "G" on the three sockets, P1, P2 and P3, and the adjacent ends of the resistors, G, H and I. These three connections take approximately ¼ inch of wire, and may be done with stiff bus bar.

Now wire the other ends of the three resistors, G, H and I, to the adjacent terminals of the three high-frequency transformers, A, B and C, leaving a



HOW TO HOOK UP THE RECEIVER FOR OPERATION

FIGURE 9: *This diagram shows the proper battery connections for the receiver, and the wiring to be made in connecting the LC-28 high-frequency pack with any low-frequency amplifier and reproducer.*



AN END VIEW OF THE SET

FIGURE 10: *This view shows clearly how the front panel is attached to the chassis by means of the sloping brackets.*

few inches extension that can be run over, later, to the three nearest terminals of the variable condensers, J1, J2 and J3.

Next, wire up the grid-circuit of the detector valve, including the grid-leak, N, and the condenser, L, as shown in Figure 3, leaving an extension to the variable condenser, J4, which can be made when the shields, R1, R2, R3 and R4, are attached.

This completes the wiring as far as it can be done and leaves open only one end of these for connection to the variable condensers.

The next job will be to install the sixteen corner posts of the four sets of shields, R1, R2, R3 and R4, by mounting them loosely in the four remaining holes left around each stage, with a screw inserted through the chassis, Y, from the bottom. When this is done, the sides of the shields are ready to be inserted into the slots in the corner pieces. However, the four sides of the shields that face the panel should be first drilled with a No. 17 drill for the hole necessary to run the wire out of the shields to the variable condensers, J1, J2, J3 and J4. This hole should be drilled exactly ¾ inch up from the bottom and centered in the middle of the shield, as shown in Figure 11. The four front sides should then be inserted and the four wires pulled through the holes and soldered to the adjacent terminals of the four condensers, J1, J2, J3 and J4.

Next, mount the two drums of the drum dial, U, by means of the flexible connections onto the extension shaft, V, which should be inserted through the three condensers, J2, J3 and J4, and onto the small shaft of the remaining condenser, J1.

The two brackets, X1 and X2, are then mounted loosely on the chassis, Y, and the front panel, W, attached to the brackets with four flat-head machine screws, spacing washers and nuts.

Next, attach two flat-head brass screws into the supporting arms of the drum through the proper holes in the panel and attach the pilot light and the front escutcheon of the drum, U. Then tighten up all screws and adjust the front panel, W, for correct position at the same time, so that the dials run smoothly. To connect the pilot light only one wire is necessary; it should run from the right-hand terminal of the pilot light (looking from the back of the set) over to the terminal connected to the frame and shaft of the switch-rheostat S.

Next, insert the other three sides to each of the four sets of shields, R1, R2, R3 and R4, and attach the tops securely with four screws, so that good contact is made all around. The set is now complete and ready for operation.

Operating Data for the LC-28

The LC-28 high-frequency pack may now be inserted in its cabinet or console, and the Yaxley cable, Q, should be attached first to the batteries or "B" power-pack, as shown in Figure 9. Then the connector may be inserted in the plug, Q, at the back of the high-frequency pack, being first sure that the combination switch rheostats are turned "off." A ground wire should be attached to the tip jack, T1, marked "Aerial," if no antenna is to be used. If, on the other hand, an antenna is employed, it should be connected to the tip jack, T1, marked "Aerial," and the ground wire should be moved over to the tip jack, T2, marked "Ground."

The high-frequency pack may be used temporarily, if necessary, with the amplifier of a previous set by connecting the two output wires to the input

SEND TO
PRECISION
FOR YOUR
LC-28 KIT

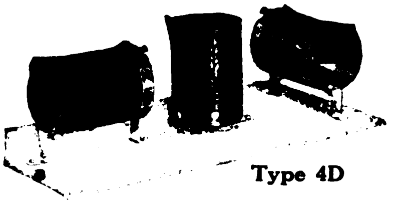
Precision Coils are in the LC-28! Mr. Cockaday likes our Coils—you'll like our kits and service. Parts exactly as specified by Mr. Cockaday.

4	Hammarlund Mid-line Variable Condensers, .000275 mfd. @ $5.10....	$20.40
1	Hammarlund double drum dial......	6.00
4	Precision type 4-B radio frequency transformers	12.50
3	Samson high frequency chokes, type No. 125 @ $2.25	6.75
1	Samson high frequency choke, type No. 85	2.00
3	Aerovox Moulded Condensers, .02 mfd. @ $1.50	4.50
1	Aerovox Moulded Condenser, .00025 mfd.	.35
1	Aerovox Moulded Condenser, .00074 mfd.	.40
1	Yaxley combination switch and rheostat, 6 ohms, No. 906-K	1.75
1	Yaxley cable connector plug with cable, type 660	3.00
4	Carter fixed resistances, 4 ohms, type H-4 @ .25	1.00
2	Carter No. 10 tip jacks @ 10c. ea. ....$.20	
1	set insulating washers for tip jack .... .05	
2	"Imp" plugs cord tip type @ 15c. ea. .... .30	.65
1	Antenna name plate .... .05	
1	Ground name plate .... .05	
4	Benjamin vibrationless sockets @ .75	3.00
1	Lynch single resistance mounting...	.35
1	Lynch Suppressor, 500 ohms	1.50
1	Lynch Suppressor, 600 ohms	1.50
1	Lynch Suppressor, 700 ohms	1.50
1	Durham Metallized resister, 6 megohms	.50
2	Tait brackets	2.00
1	Alcoa aluminum chassis	7.50
4	Sets special aluminum box shields for LC-28 @ $2.00	8.00
1	Aluminum panel, 6-in. by 26-in.	4.50
1	¼-in. extension shaft	.50
	TOTAL	$90.15

New Coils

The New Precision *Diamond Cut* Coils are a quality product.

The rigidity of the bakelite form assures you that the inductance will be the same five years hence as it is now. The spacing between wires is obtained by cutting the bakelite with Diamond edges. This gives accurate spacing between wires, and each coil is so spaced that the lowest distributed capacity is obtained.


Type 4D

Radio-Frequency Transformers

Here is an accurate radio-frequency transformer for a .00035 condenser. It is especially designed for the present broadcast range and the secondaries are wound to an accuracy of one per cent. A set of three coils, $5.00.

Send for our new catalogue

Precision Coil Co., Inc.
209 Centre St. New York., N.Y.

LYNCH RESISTORS

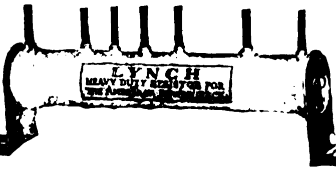
An EASY way to improve the TONE of your radio set
LYNCH
resistance-coupled amplifier KIT $9.00

The *Complete* Resistance Line

is a result of the focusing of the efforts of an organization, trained in the development and production of quality resistors, to the problem of supplying every resistance need of the manufacturer, engineer and radio fan.

This line includes every type of resistor required for receiving, transmitting and power supply work.

The stock sizes of Lynch Resistors have been carefully selected to meet the ordinary requirements of the average circuits. Special resistors of any desired sizes or characteristics can be had to order.



Tapped heavy duty type resistor for power amplifiers and battery eliminator circuits such as the Mayolian 171 and 210, the AmerTran and Silver Power Packs, and Thordarson 171 and 210. Price of AmerTran Tapped Resistor illustrated—$8.50.

Metallized resistors give continuous, conductive, non-arcing, noiseless and permanent resistance. They are available in sizes ranging from .25 to 10 megohms at 50 cents each; .012 to .2 megohm at 75 cents each; and .0005 to .01 megohm at $1.00 each.

and

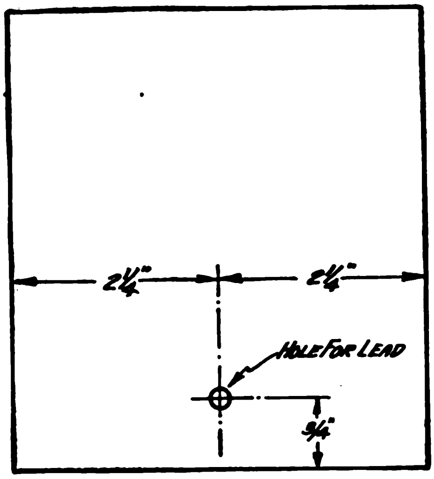
NOW!!!

"Resistance—The Control Valve of Radio"

THE LYNCH RESISTORS BOOK JUST OFF THE PRESS

A very thorough treatise on the proper use of resistors for every radio resistance need. Many pages, many illustrations, many new ideas. In fact, many dollars' worth of information for a quarter. If your dealer can not supply you send your quarters' worth of stamps for the real dope on amplifier, power amplifier, and battery eliminator circuits.

ARTHUR H. LYNCH, INC.
General Motors Building
1775 Broadway, at 57th St., New York, N.Y.



HOW TO DRILL THE STAGE SHIELD

FIGURE 11: *This diagram shows the correct position for the hole to be drilled in the front side of each stage shield for the wire that connects to the stator of each condenser.*

terminals of the amplifier with which it is to be used, as shown in Figure 9.

The LC-28 high-frequency pack may also be used with any complete low-frequency amplifier in the same manner. Any of the amplifiers described in the series, "How to Get Quality Amplification," now running in POPULAR RADIO, will be found exceptionally well suited to the LC-28.

Or, if the reader has any particular preference in amplification, whether it be transformer coupling, impedance coupling, resistance coupling or a combination, an amplifier embodying these principles may be connected with the LC-28 within a few minutes' time and the set put into operation.

The tuning of the antenna circuit is accomplished with the left-hand knurled disc of the double-drum dial, U, and the three remaining stages are tuned with the right-hand knurled disc of the drum dial, U. All volume control is accomplished with the switch, S.

Place three Zetka RF valves in the sockets, P1, P2 and P3, for maximum results. These valves are really power valves and are designed with an exceptionally low value of plate impedance; they draw slightly less than ¼ ampere in the filament circuit and give a very high order of amplification.

However, the ordinary standard UX-201-a type valves may be used with excellent results.

In the detector socket, P4, a Z-200-a or a UX-200-a type valve should be used.

To insert these valves, it is necessary to take off the tops of the four shields, R1, R2, R3 and R4, after which they should be replaced and tightened down securely.

This set, in New York City, *without an antenna,* has been able to duplicate, with a large margin to spare, the results obtained with the LC-27 *on a very satisfactory antenna.*

YOU NEED THIS BOOK

Just Out
HARRY
ALTER'S
New Radio Book

You, as a retailer, need the extra profit that is figured for you in our plan of selling at rock-bottom prices. Fourteen thousand dealers are sharing in the advantages of our overnight service.

JUST OUT! WRITE TODAY!

for your copy of this—the most famous of all radio catalogs. No matter what your customer wants we have it for you. Get your copy quick.

Note: We sell only to radio retailers.

The Harry Alter Co.
1762 Michigan Ave. Chicago, Ill.

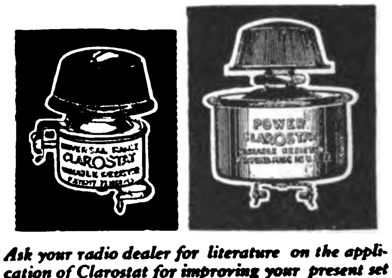
Follow the Specifications!

In seeking the *reliability* of fixed resistance with the convenience of *variable* resistance, radio authorities invariably specify CLAROSTAT. Manufacturers of better grade radio power units invariably use CLAROSTAT. Radio laboratory workers invariably employ

CLAROSTAT

Why? Over five years of persistent, concentrated, specialized efforts have gone into developing the present CLAROSTATS. An entire plant is devoted to making just CLAROSTATS. Specialization, then, has produced the desired result.

Now you may be offered devices "just as good as the CLAROSTAT." You may be imposed upon with imitations at bargain prices. But if you seek results, follow the specifications! Use only the standard of variable resistance, which you will find in the familiar green box and bearing the name CLAROSTAT stamped on the nickel-plated shell of the Universal type (20 watt) and the Power type (40 watt).



Ask your radio dealer for literature on the application of Clarostat for improving your present set or building a better one—or write us direct.

MEMBER RMA

American Mechanical Laboratories, Inc.
Members R. M. A.
Specialists in Variable Resistors
285 North 6th St. Brooklyn, N. Y.

Without using an antenna the LC-28 has brought in, during summer in New York, stations from the Pacific Coast, from northwestern Canada, from Mexico, Florida, Maine, Chicago, and intervening locations. And it is possible to obtain these through local broadcasting under ordinary conditions.

In the November issue of POPULAR RADIO will be described "How to Build and Operate the LC-28 Unipac," the first of a series of combined amplifiers and power-packs for use with the LC-28 for varying conditions of quality, volume and price. This coming series will include transformer-coupling, resistance-coupling, impedance-coupling and push-pull amplification, and combinations of both, so that every set constructor may have just the type of amplification that he wishes to use with the LC-28.

ADVANCE INFORMATION ON
The LC-28 Unipac Amplifier

FOR those who must do most of their radio shopping out of town, and who want to be ready to complete the LC-28 receiver as soon as the November issue of POPULAR RADIO is issued, the Editors are publishing below the list of parts specified for this unit:

1 S-M 328 full-wave, super-power transformer;
1 S-M 331 Unichoke filter system;
2 S-M 240 audio transformers;
1 S-M 241 output transformer;
1 Tobe 662 condenser bank;
5 S-M 511 valve sockets;
1 Ward-Leonard S-651 resistor kit;
4 Frost 253 tip jacks;
1 Van Doorn 661 steel chassis and cabinet with hardware;
3 Eby binding posts (B—, 45+, 90+);
20 feet of Kellogg hook-up wire;
2 Frost FT 64 resistors;
1 Frost F 1500 resistor;
1 CX-326 1.5 AC amplifier valve;
1 CX-310 power amplifier valve;
1 CX-374 glow valve;
2 CX-316B rectifiers.

NOTE: The use of two CX-381 rectifiers is to be preferred instead of CX-316-b's due to greater life and slightly higher output voltage.

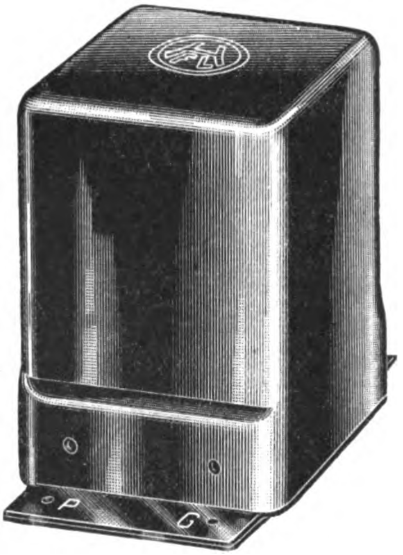
The unit the parts for which are listed above is a complete two-stage low-frequency amplifier with "ABC" power supply and receiver "B" supply, operating entirely from a 105-120-volt, 60-cycle light socket. Designed especially for use with the new LC-28 receiver, it will serve as a very high quality and powerful low-frequency amplifier and "B" power-pack, in connection with any standard receiver that contains no low-frequency amplifier. It will also function as a complete light-socket-operated phonograph amplifier, upon the addition of a reproducer and magnetic phonograph pick-up, such as the Pacent Phonovox. Thus the amplifier, loudspeaker and pick-up allow the complete electrification of any existing mechanical phonograph, with results equal or superior to those obtainable from the more expensive phonograph models that are now on the market.

HFL

Transformers

Two Additions to Last Year's Radio Sensation. The Amazing Achievement in Audio Amplification

Designed for set builders who demand precision, sensitivity, high quality and efficiency



H. F. L. C-16 Audio Transformers and C-25 Output Transformer—New companions of a Great Unit, will work in any circuit and improve any radio set

RADIO MANUFACTURERS' ASSOCIATION MEMBER RMA

H. F. L. Units Give Wonderful Clear Reception

Engineers acclaim H. F. L. C-16 a marvellously efficient Audio Transformer. It carries signals at highest volume and lowest amplitude without blasting or developing harmonics. Operates with all power tubes as well as standard tubes.

H. F. L. C-25 Output Transformer handles the voltage output of power amplifying tubes, at the same time matches the impedance of the average speaker to tubes. Protects loud speaker unit without reducing plate voltage.

Mechanical features of these two transformers are: A coil designed and treated to exclude moisture and withstand heavy electrical surges without breaking down—complete magnetic shielding to avoid inter-stage coupling—terminals brought out so as to insure short leads.

Set Builders—Dealers

If your jobber cannot supply you with H. F. L. Transformers, wire us for name of nearest jobber.

H. F. L. Facts

H. F. L. Units have been used, approved and most highly endorsed by leading Radio Engineers. Thousands of engineers and fans, who have turned to H. F. L. Units for better reception, hail them as the finest transformers known to Radio —unexcelled for Power, Selectivity and Purity of Tone.

All H. F. L. transformers are designed for baseboard mounting or invisible sub-panel wiring—each unit is enclosed and sealed in a genuine bakelite moulding.

H. F. L. Units are easily connected into the assembly, simplify set construction, and make a beautiful, finished job.

PRICES

H-210 Transformer....	$8.00
H-215 Transformer....	8.00
C-16 Transformer......	8.00
L-425 R. F. Choke....	5.50
L-430 R. F. Transformer	5.50
C-25 Output Transformer	8.00

HIGH FREQUENCY LABORATORIES
131-F NORTH WELLS STREET, CHICAGO, ILL.

RADIO PROBLEMS SOLVED

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently; look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c a copy.

October, 1926
—How to Build the New LC-27 Receiver.
—The Radio Road Hog.
—POPULAR RADIO Circuits.
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-Pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits.
—How to Build the LC-Intermediate Power-Pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC Junior Power-Pack.

POPULAR RADIO
119 West 57th Street New York, N. Y.

LOOK!

The Last Word in RADIO

Radio is an *exact* science, yet so new there is still much that is incorrect and unscientific in present equipment. The results are faulty reception and complaints.

To meet this need we have compiled the exact facts covering the entire scope of radio science and every type of receiver into one big, fine, new book. With it you can now *Be The Man Who Knows!*

DRAKE'S RADIO CYCLOPEDIA

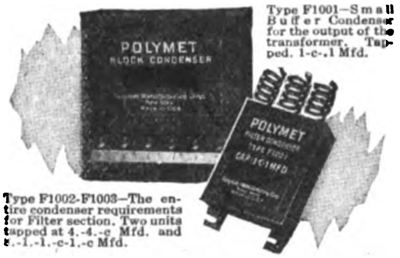
Solves the Dealer's Service Problems

If you design, build, repair or service radio receivers you need this book. All subjects alphabetically arranged, with hundreds of cross references so you quickly find what you want. 1672 headings, 985 illustrations, 871 pages. Nothing else like it. It is *the* book of radio, just out. SEND TODAY. $6.00 postpaid. Also for sale at all bookstores.

Big catalog of useful books sent free

FREDERICK J. DRAKE & CO.
Publishers
1011 S. Michigan Blvd., Chicago

Use Polymet Products



Type F1001—Small Buffer Condenser for the output of the transformer. Tapped. 1-c-.1 Mfd.

Type F1002-F1003—The entire condenser requirements for Filter section. Two units tapped at 4.-4.-c Mfd. and 1.-1.-1.-c-1.-c Mfd.

***For* RAYTHEON "ABC" Eliminators**

For efficiency and permanent satisfaction you can't beat Polymet Products.

More and more Radio Engineers are every day specifying Polymet Products because they know by experimentation that they are the leaders. To insure lasting, satisfactory results for Battery Eliminators, Power-Packs and Electric Sets buy only Polymet "better made Radio Essentials." They are the best.

Send for our latest booklet showing some of the most popular circuits and the complete line of Polymet Products.

Polymet
Manufacturing Corporation
599 Broadway, N.Y.

POLYMET PRODUCTS

BROADCASTS

Photo-Electric Cell Performs Novel Stunt

BY means of a photo-electric cell, a one-candlepower flashlight in New York recently turned on the 1,380,000-candlepower searchlight erected at Charlottesville, Va. When the flashlight beam fell on the light-sensitive cell, an electric current was sent over wire and actuated an electric relay that turned on the power for the searchlight. In like manner, the first glow of the searchlight at Charlottesville operated a photoelectric cell that turned on a flood light in City Hall, New York City; this light illuminated a portrait of Thomas Jefferson, in whose honor the Charlottesville beacon was named. The beacon is intended as a guide post for airplanes and is the largest searchlight ever constructed.

* *

An Automatic Radio Ship Announcer

A PATENT has been granted to Elmer Sperry, of Brooklyn, for a radio device that automatically broadcasts the name, position and speed of a ship.

The device is a cylindrical machine, about the shape of a top hat, which is connected with the compass of the vessel. As the compass gives the position of the ship, impulses are sent out by radio to shore stations in communication with the ship. Similarly, the machine is geared to the propellers of the vessel and the speed of the ship is ascertained from this connection. The device also sends out the name of the vessel.

* *

An Outdoor Radio Game

FROM England comes an outdoor sport centering about radio. At a recent meeting of a British radio society, a small radio broadcasting station was set up secretly in one of the houses of a farm to broadcast radio signals at intervals. The members of the society, scattered about in the surrounding country, sought to locate it. Mr. Maurice Child, using an apparatus to detect the direction from which radio waves are arriving, made three readings at points a few miles apart, combined these on a map according to the well-known surveyor's method of triangulation, and located the "quarry," winning the prize offered by the *Wireless World*, a British radio magazine.

* *

Radio and Movies Combined for Broadcast Lectures

A METHOD has recently been perfected in Germany for combining movies with radio for the purpose of illustrating broadcast lectures. In each auditorium where the broadcast lecture is to be heard, the illustrative films are run on a projector geared to a motor that is synchronized with all the other motors in the lecture hook-up. The lecturer watches one of the projections, or a private projection in his study, and times the remarks he is broadcasting to fit the scenes being illustrated.

* *

The First Book on Radio Law

THE first book to deal with the complexities of radio law has been published by the McGraw-Hill Company of New York. It is entitled "The Law of Radio Communication," and was written by Judge Stephen B. Davis, formerly a solicitor in the Department of Commerce and aide to Secretary Hoover in the control of radio. The book considers most of the controversial legal phases of radio today, such as federal jurisdiction, state jurisdiction, conflicting rights in reception and transmission, property rights, the broadcasting of copyright matter, the control of broadcasting programs, libel and slander, and international law.

* *

Caucasus Priests See "Deviltry" in Radio

RADIO progress in Svanetia, a wild district on the slopes of the Caucasus Mountains, is not encouraged by the Mohammedan priests, or Mullahs, who look on the strange "spirit-speaker" from the West as an instrument of the devil. Recently a receiving set was publicly damned before a huge crowd and then thrown down a precipice.

Adopting suggestions made by Laurence M. Cockaday, Zetka Laboratories have produced a new tube . . . a ¼ amp. Radio Frequency Amplifier . . . the ZRF. Experimentation has brought out the startling fact that with the use of the ZRF *over 33% greater amplification per stage* is obtainable than with standard tubes.

It was found that in RF, the mu of the tube played a very small part in obtaining this great amplification, due to the large effective capacity of high mu tubes at high frequencies. The main factors are a low input capacity between the elements (which goes with a low mu) and a low plate impedance.

The plate resistance of the ZRF is lower by one-half than that of standard tubes, resulting not only in far greater amplication, but in infinitely better tone qualities. Price $4.50.

In conjunction with the ZRF, there has been developed a special Detector—the Z 200 A—absolutely free of the objectionable fry, spatter and hiss under *all* conditions. Price $4.00.

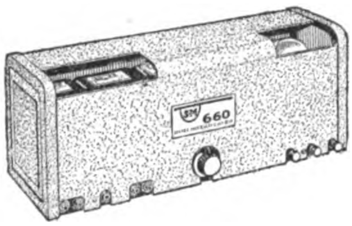
For Audio Amplification—ZP 201 A, the ¼ amp. All-stage Power Tube has been redesigned more ruggedly. May also be used as a detector.

Experimenters, engineers and dealers are invited to write our laboratories for actual detailed characteristics of the complete line of Zetka Clear-glass Tubes.

ZETKA LABORATORIES, INC., 73 Winthrop St., Newark, N. J.

ZETKA

The *Clear-Glass* Tube



SM

The LC-28 UNIPAC

Parts for the LC-28 Unipac—the amplifier and power supply exactly as specified by Laurence Cockaday for the new Popular Radio LC-28 circuit, are now ready at your nearest dealer. The parts chosen by Mr. Cockaday are:

1—S-M Super power transformer	$18.00
1—S-M 331 Unichoke	8.00
2—S-M 240 audio transformers	12.00
1—S-M 241 output transformer	5.00
1—Tobe 662 condenser bank	18.00
5—S-M 511 tube sockets	2.50
1—Ward-Leonard 651 resistor kit	7.00
4—Frost 253 tip jacks	.60
1—Van Doorn chassis and cabinet	8.00
3—Eby binding posts	.45
20—ft. Kellog hook-up wire	.20
2—Frost FT-64 resistors	1.00
1—Frost F-1000 resistor	.50
Total	$81.25

The LC-28 Unipac, just like all other Unipacs, is designed particularly for the man who is content only with reproduction that is truly realistic, and the choice for the LC-28 is insurance that the new Cockaday receiver has tone quality unbeatable. The Unipacs are as far ahead of any ordinary amplifier as the cone is ahead of the 1920 "loud speaker." Each Unipac provides positively marvelous realism of sound reproduction — each offers the same fine qualities that have placed Silver-Marshall transformers far in the lead of audio amplfication. All are housed in attractive brown crackle steel cases and will provide B power to the entire receiver, in some cases A, B and C power. They may be built as phonograph amplifiers, one or two stage, push-pull or straight amplifiers, ABC supplies—in fact, are of universal application. Two other outstanding models of the S-M Unipac line are the 660-210 and the 660-171 kits. 660-210 is a push-pull 210 power pack delivering from 4 to 17 times more power than any other 210 packs, with quality of reproduction guaranteed unequalled by any other known amplifier, and is priced at $83.25. 660-171 kit is a push-pull 171 amplifier and B supply especially recommended as a third power stage for the new Infradyne or similar receivers, to which it also supplies all B power. Actually, it is more powerful than the average 210 power packs. Price, $64.00.

SILVER-MARSHALL, Inc.
844 WEST JACKSON BLVD.
CHICAGO, U. S. A.

Radio Enters the Show Business

BROADCASTING, which started as a part of the electrical business, has developed into an important member of the show business. Payrolls of from $500 to $2,000 a night are paid out for talent alone on the big chains; outstanding entertainers are reported as getting as much as $2,000 for a single short appearance before the mike. And radio is making its own artists, too. So great has been the demand of the public to see radio artists face to face that a broadcasting chain has established a bureau to provide personal appearances for its own artists.

* *

A New Station for Transatlantic Radio

CONSIDERABLE improvement in the transatlantic radio telephone service is promised by the construction of a new radio station now being built by the British Government at Cupar, Scotland.

Measurements and tests carried out in 1925 indicated that the north of the British Isles was the ideal situation for transmission and reception of telephonic conversation with the United States, and Cupar was decided upon as the best available location. This station will supersede the present station at Wroughton, Wiltshire, which is about eighty miles from London.

* *

Feeding Lines to the Announcer

THE introductory remarks which appear to fall so extemporaneously from the announcer's lips are, according to the most modern studio technique, written down beforehand and carefully planned. Broadcasting has to be run according to a schedule in which every second counts. The words that are spoken must be timed.

* *

Radio "Mileposts" for Airplanes

THE radio beacon system for use in airplane navigation has been progressing under the experimentation of the Bureau of Standards at the demonstration station at College Park, Md., on the New York-Atlanta airway. The system as it will be developed will incorporate three radio devices. The first is the directive radio beacon that sends out a special type of radio beam by which airplane pilots are able to follow the designated course in total darkness or fog. The system also makes use of marker beacons placed at intervals of about 25 miles along the air route; these will act as radio mileposts. Supplementing these, radio telephony will be used to inform the pilot of landing conditions and weather expectations. The control of all these devices will be centered at the airports. The control center will also be equipped with receiving apparatus to receive messages from such airplanes as are equipped with transmitting apparatus.

* *

An All-European Broadcast Program

AN all-European musical concert, to which a dozen widely separated cities contributed, recently was broadcast by Copenhagen radio stations.

During a period of three hours, by means of relaying, the Danish radio public was able to hear London, Paris, Toulouse, Berne, Prague, Langenberg Moscow, Daventry, Bruxelles, Oslo, Frankfurt and Lyons. The concert was exceedingly popular with the Danish radio public.

* *

Radio Broadcasts a Song Unheard by Human Ear

THE superiority of modern radio apparatus to the human ear, considered as a listening device, was demonstrated recently in England during an attempt to broadcast the song of that seldom-heard bird, the nightingale. A feathered songster far off in the distance burst into song while the experiment was going on. The engineers at the microphone heard nothing, but the song was picked up by the especially sensitive microphone that was being used and was broadcast, without the knowledge of the engineers.

* *

A Radio "Shadow"

AN American destroyer division reports that there is a radio "shadow" along the north side of Haiti, which makes it impossible for ships cruising along the north side of the island to communicate with vessels on the south side during the times when the high mountains of Central Haiti intervene.

* *

A Correction in the July-August Number

DAVID LAY'S mathematics were in error in the article entitled "The New Exponential Horn," in the July-August number. At the bottom of the second column, on page 23, the article reads:

> "If roots are to be expressed instead of powers, the exponent is negative. For example, an exponent of —2 indicates the square root, an exponent of —3 indicates a cube root, and so on."

This should have read:

> "If roots are to be expressed instead of powers, the exponent is fractional. For example, an exponent of ½ indicates the square root, an exponent of 1/3 indicates the cube root, and so on."

A negative exponent indicates that the reciprocal of the number is to be raised to the power indicated.

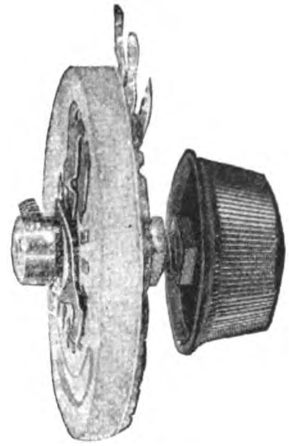
VITROHM RESISTORS *and* RHEOSTATS

Vitrohm Radio Resistors

WARD LEONARD Resistors and Rheostats are now available to the experimenter and home constructor in 93 types and styles covering the resistance demands of *every* current supply circuit.

A few of these products are listed on this page. A full description is contained in Radio Bulletin 507 which will be sent you without charge.

"Vitrohm News", a monthly Bulletin covering circuits and items of interest to the radio fan, was first published in September. This copy and subsequent issues will be sent you upon request.



THE ADJUSTAT

The Adjustat

The Vitrohm Adjustat is a 15-step potentiometer connected rheostat adapted for use in all current supply circuits. Like all Vitrohm Products, the resistive element, wire, is embedded in and protected by fused-on vitreous enamel.

The Adjustat is priced at $3.00.

TYPES

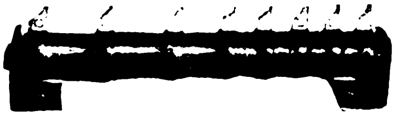
507-79	1 ohm	4000 m. a.	507-81	600 ohms	180 m. a.
507-71	2 ohms	3000 m. a.	507-75	1000 ohms	125 m. a.
507-72	6 ohms	1500 m. a.	507-76	2250 ohms	90 m. a.
507-73	20 ohms	1000 m. a.	507-84	7500 ohms	50 m. a.
507-74	30 ohms	800 m. a.	507-77	10,000 ohms	40 m. a.
507-80	50 ohms	650 m. a.	507-78	25,000 ohms	20 m a.

Resistor 507-66

Vitrohm Resistor 507-66 is a transmitting grid leak for circuits up to and including 1000 watts inputs. It is particularly recommended for circuits employing the R. C. A. UX852 Tube.

Total resistance 15,000 ohms, tapped at 5000 and 10,000 ohms. $6.00

RESISTOR 507-66



RESISTOR 507-9

Resistor 507-9

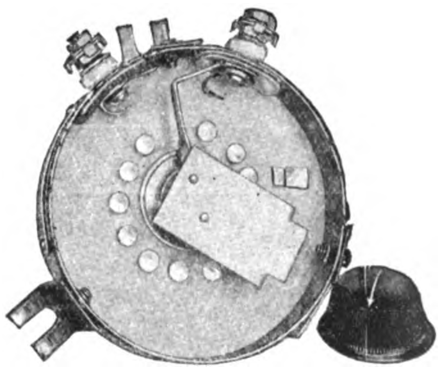
This resistor is for use in B & C Supply Circuits having an output under load of 180 volts. At this voltage, intermediate voltages of 22, 45, 67, 90 and 135 are available. Priced at $6.75.

Vitrohm HEAVY DUTY Rheostat

The Vitrohm *heavy duty* Rheostat has 11 steps of adjustable resistance. It is particularly adaptable for use in series with transformer primaries to compensate for line voltage changes. These Rheostats are 4 inches in diameter and are arranged for either base or panel mounting. $5.50.

TYPES

507-83	12.5 ohms	2200 m. a.
507-59	20 ohms	2000 m. a.
507-63	50 ohms	1000 m. a.



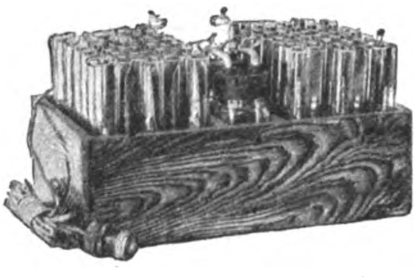
VITROHM *HEAVY DUTY* RHEOSTAT

Ward Leonard Electric Company

31-41 South Street Mount Vernon, N. Y.

resistor specialists for more than 35 years

90 Volt Power Unit :: $12.75



Hums, line noises, etc., positively impossible with this new advanced unit. Plug in and forget. Non-acid and noiseless. All detector and intermediate voltages plainly marked. Simpler to hook up than dry cells. Operates any type set 1 to 12 tubes. Greater volume and clearness guaranteed. If not thoroughly satisfied, return after using 30 days for complete refund. Guaranteed further 2 years. For 110-120 volts AC 25 to 60-cycle current. 90 volts, $12.75; 112½, $15.25; 135, $17.50; 157½, $19.50; 180, $24.00; 202½, $26.00.

Also built for DC current, 110 and 32 volts, at only $3.00 additional, any size above. Ample stocks—same day shipments. Simply say—ship C.O.D. or write for my interesting literature, testimonials, etc.

B. HAWLEY SMITH

334 Washington Ave., Danbury, Conn., U. S. A.

Standard parts and equipment at money-saving prices, with discounts that show you a real profit. Electrical Phonograph—pick-ups—latest kits! New A C tubes and transformers—parts for any circuit—power audio equipment—short-wave supplies—they are all in our big new 1928 Catalogue. Write for it today, with discount sheet. 12-hour shipment guaranteed.

Van-Ashe Radio Co.

204 North 10th ST. ST. LOUIS, MO.

Transoceanic Calls Heard

POPULAR RADIO has just received a card from W. B. Jennings (NU-1ON), 26 Tapley Street, Lynn, Mass., thanking us for forwarding to him some calls heard (QSL) cards from station EF-8EZ in France.

POPULAR RADIO is doing this same service for all other American amateurs. Arrangements have also been completed for forwarding American QSL cards for their proper destinations in foreign countries. This delivery is made through local agents in those countries who have or can obtain the present address of foreign amateurs. American amateurs are invited to send their cards to foreign amateurs through this office, which will not only assure safe delivery through the special agencies which are thus provided, but which will publish a monthly list in a "Transoceanic Calls Heard" department.

Address your cards to the foreign amateurs by call numbers and enclose them in an envelope to—

The Calls Heard Editor,
POPULAR RADIO,
119 West 57th Street, New York.

THE following stations were received and logged at the amateur station of Roger Pieton (EF-R390) at 92, Rue Riquet, Toulouse, France, using a Bourne receiver with one stage of low frequency:

NU-2CUZ—July 13, 1927; signal strength R8; stable DC note on 20.65 meters;
NU-6BJF—July 14, 1927; signal strength R6; rectified AC note on 20.30 meters; fading;
NU-2BBB—July 14, 1927; signal strength R8; steady rectified AC note 21.65 meters;
NU-6ASZ—July 14, 1927; signal strength R8; steady rectified AC note on 20.50 meters;
NU-8ARO—July 14, 1927; signal strength R9; steady rectified AC note on 20.65 meters;
NU-1DM—July 11, 1927; signal strength R7; stable DC note on 18.8 meters;
NU-2AUE—July 11, 1927; signal strength R6; stable rectified AC note on 20 meters;
NU-1CJH—July 11, 1927; signal strength R7; stable rectified AC note on 20.4 meters;
NU-1AD—July 11, 1927; signal strength R8; stable rectified AC note on 21 meters;
NU-1AXX—July 10, 1927; signal strength R4; DC note on 20 meters; fading;
NE-1BY—June 6, 1927; signal strength R3; stable rectified AC note on 20 meters;
NA-9KV—June 8, 1927; signal strength R8; stable rectified AC note on 20 meters;
NT-8AF—June 26, 1927; signal strength R7; rectified AC note on 20 meters; fading;
NU-1CTU—July 11, 1927; signal strength R8; steady rectified AC note on 20.3 meters;
NU-8BEN—July 19, 1927; signal strength R8; steady rectified AC note on 20.9 meters;
NU-8BAG—July 19, 1927; signal strength R6; steady DC note on 19.8 meters;
NU-2DR—July 19, 1927; signal strength R8; steady rectified AC note on 20.3 meters;
NU-1BBO—July 14, 1927; signal strength R7; steady rectified AC note on 18.4 meters;
NU-1BKP—July 15, 1927; signal strength R5; steady rectified AC note on 20.5 meters;
NU-1BAT—July 16, 1927; signal strength R4; DC note on 20.9 meters; fading.

THE following stations were received and logged at the amateur station of L. Berger (EF-8OEO), at Villa Babiole, Cambo, Basses Pyrenees, France, with a cage antenna and counterpoise and one stage of low frequency:

NU-3IU—April 6, 1927; signal strength R6-7; rectified AC note on 41 meters; bad static;
NU-8ANC—April 6, 1927; signal strength R4; DC note on 40 meters; bad static;
NU-1CD—March 13, 1927; signal strength R6; DC note on 40 meters; atmospherics;
NU-5EK—March 13, 1927; signal strength R6; good rectified AC note on 42 meters; much static;
NU-2GU—March 13, 1927; signal strength R6; rectified AC note on 42 meters; much static;
NU-2CVJ—April 17, 1927; signal strength R8; rectified AC note on 40 meters; no fading;
NU-1BGD—April 17, 1927; signal strength R6; rectified AC note on 40 meters;
NU-8CWT—Feb. 27, 1927; signal strength R2-3; DC note on 41 meters; much interference and static;
NU-2BCM—Feb. 27, 1927; signal strength R6; rectified AC note on 42 meters; interference;
NU-1CD—Feb. 27, 1927; signal strength R2-3; rectified AC note on 42 meters; much interference and static;
NU-1BBM—Feb. 27, 1927; signal strength R6; rectified AC note on 42 meters; atmospherics;
NU-1CSX—April 14, 1927; signal strength R6; rectified AC note on 41 meters; atmospherics;
NU-1AIX—April 14, 1927; signal strength R1; DC note on 40 meters; much static;
NU-3JU—April 14, 1927; signal strength R6-7; rectified AC note on 40 meters; bad atmospherics;
NU-8AXA—April 26, 1927; signal strength R1; DC note 41 meters; much static;
NU-1BZQ—April 14, 1927; signal strength R3-4; rectified AC note on 41 meters.

THE following stations were received and logged at the amateur station EF-8HIP, Paris, France, using a Schnell receiver with one stage of low frequency:

NU-8AXA—July 21, 1927; signal strength R3; good rectified AC note on 20 meters;
NU-8CFR—July 19, 1927; signal strength R4; steady rectified AC note on 20 meters;
NU-1AXA—July 1, 1927; signal strength R7; steady rectified AC note on 20 meters;
NU-1BYV—July 1, 1927; signal strength R5-6; rectified AC note on 20 meters;
NU-2AOL—July 1, 1927; signal strength R4-5; rectified AC note on 20 meters;
NU-2AGN—June 28, 1927; signal strength R5; steady rectified AC note on 20 meters;
NU-1BEB—July 1, 1927; signal strength R4; very fine rectified AC note on 20 meters;
NU-2UR—July 1, 1927; signal strength R4-5; good rectified AC note on 20 meters;
NU-2AYJ—July 11, 1927; signal strength R3-5; rectified AC note;
NU-1BIV—June 30, 1927; signal strength R3-4; rectified AC note on 20 meters;
NU-8ADG—June 29, 1927; signal strength R8; good rectified AC note on 20 meters.

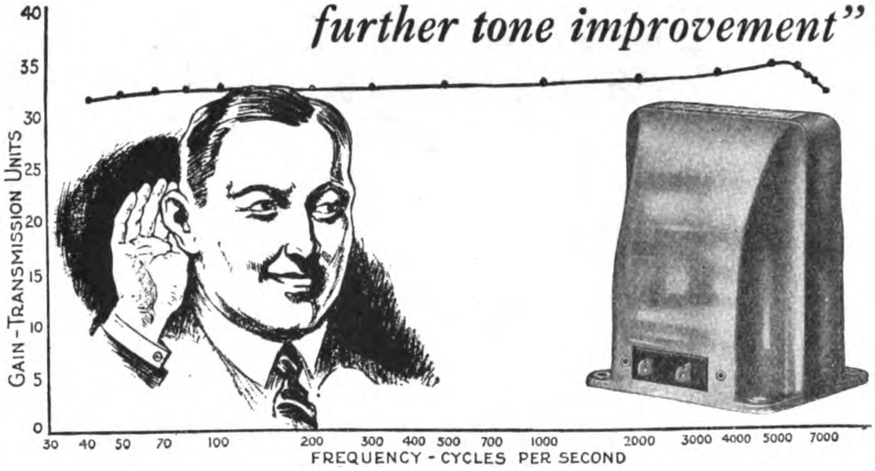
THE following stations were received and logged at the amateur station G. Baron (EF-8BRN), at Rouen, France, using a Schnell receiver and a single-wire antenna:

NU-9ADK—March 23, 1927; signal strength R5; DC note; slight interference;
NU-8BAJ—March 24, 1927; signal strength R3; heavy static;
NU-8ADM—March 15, 1927; signal strength R7; rectified AC note;
NU-4HY—March 15, 1927; signal strength R7-8; no fading;
NU-2LE—Feb. 27, 1927; signal strength R5; DC note; some interference;
NU-2AKJ—March 21, 1927; signal strength R6; some static;
NU-1ID—April 3, 1927; signal strength; rectified AC note;
NU-4TV—April 20, 1927; signal strength; R7; rectified AC note;
NU-2AVR—April 30, 1927; signal strength R6-7; rectified AC note;
NU-2AFM—May 2, 1927; signal strength R6;
NU-2AHM—April 26, 1927; signal strength R5; DC note on 36 meters;
NU-2AEF—April 30, 1927; signal strength R4; rectified AC note; some interference and much static;
NU-1AVL—April 30, 1927; signal strength R7; rectified AC note;
NU-1AFL—May 2, 1927; signal strength R7;
NU-2BOW—May 1, 1927; signal strength R8; some fading;
NU-1MV—March 25, 1927; signal strength R6;
NU-1CD—March 26, 1927; signal strength R6; slight interference;
NU-1CKP—March 15, 1927; signal strength R8; interference; slight fading;
NU-1RN—March 15, 1927; signal strength R5; much interference; slight fading.

THE following stations were received and logged at the amateur station of A. Cremailh (EF-8JZ), at 15, Rue de Vitre, Rennes, France, using detector and one stage of low frequency:

NU-3TN—April 7, 1927; signal strength R5; good rectified AC note on 39 meters; no fading;
NU-2AO—April 7, 1927; signal strength R6; AC note on 38 meters; no fading;
NU-9BCL—April 7, 1927; signal strength R6-7; good rectified AC note on 37 meters;
NU-4LD—April 7, 1927; signal strength R6-7; good rectified AC note on 36 meters;
NU-3AGM—March 27, 1927; signal strength R6; 41 meters;
NU-3UD—April 3, 1927; signal strength R6; AC note on 42 meters; no fading;
NU-1BKE—April 2, 1927; signal strength R6; 37 meters;
NU-2AVG—March 27, 1927; signal strength R6; good rectified AC note on 37 meters;
NU-3LL—March 29, 1927; signal strength R6; good rectified AC note on 41 meters;
NU-1AVG—March 27, 1927; signal strength R6; DC note on 36 meters;
NU-1VZ—March 27, 1927; signal strength R6; DC note on 36 meters;
NU-2AZK—March 29, 1927; signal strength R5; rectified AC note on 37 meters;
NU-2ATX—April 3, 1927; signal strength R6-7; very good rectified AC note on 37 meters;
NU-2FC—April 3, 1927; signal strength R7; good rectified AC note on 36 meters;
NU-2BEM—April 3, 1927; signal strength R6-7; AC note on 41 meters.

"The human ear could not detect further tone improvement"



Engineers told us this as Samson Symphonic Transformers were tested in famous laboratories. Musicians confirmed it frequently.

The curve above shows audible music is amplified with remarkable evenness from lowest to highest frequency. This frequency characteristic of the Symphonic Transformer is more uniform than that of the average broadcast station or any loud speaker in common use. Samson power units will supply dependable A, B and C current for the above.

"Audio Amplification," a book rich in highly practical original information for bettering quality of reproduction, sent on receipt of 25 cents.
Learn how to get supreme coil efficiency from new "Inductance Units Bulletin." Send 10 cents to cover mailing.

How to apply RF and AF Chokes to 17 popular circuits, or your own, is illustrated in Make-Em-Better Sheet. Send 5 cents to cover mailing.

Send 10 cents for *"B Eliminator and Power Amplifier Construction."*

SAMSON ELECTRIC COMPANY

Manufacturers Since 1882 **Principal Office: Canton, Mass.**

First in the Field Specializing in Cockaday Kits

S. HAMMER RADIO CO., 303 Atkins Ave. Brooklyn, New York

Cockaday Sets Now Made Easier to Build by Our New "Ready-to-Wire" Plan

50% of Your Time, Work and Worry SAVED!

All you need do is to connect bus-bar according to diagram, solder and your set is finished. These Kits are sent to you completely mounted, and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved. Genuine parts used as listed below; exactly as used in Mr. Cockaday's Laboratory Model. COMPARE OUR OFFER!

***NEW!* COCKADAY LC-28 RECEIVER**

4 Hammarlund Mid-Line Variable Condensers, .000275 mfd. @ $5.10	$20.40
1 Hammarlund Double Drum Dial	6.00
1 Set of Precision Radio Frequency Transformers, type 4-B	12.50
3 Samson High Frequency Chokes, type No. 125, @ $2.25	6.75
1 Samson High Frequency Choke, type No. 85	2.00
3 Aerovox Moulded Condensers, .02 mfd., @ $1.50	4.50
1 Aerovox Moulded Condenser, .00025 mfd.	.35
1 Aerovox Moulded Condenser, .00075 mfd.	.40
1 Yaxley Combination Switch and Rheostat, 6 ohms, No. 906-K	1.75
1 Yaxley Cable Connector Plug with Cable, type 660	3.00
4 Carter Fixed Resistance 4 ohms, type H-4, @ 25c	1.00
2 Carter Imp. Plugs and Tip Jacks, marked "antenna" and "ground," respectively, with insulating washers for antenna jack. Complete set	$0.65
4 Benjamin Vibrationless Sockets @ 75c	3.00
1 Lynch Single Resistance Mountings	.35
1 Lynch Suppressor, 500 ohms	1.50
1 Lynch Suppressor, 600 ohms	1.50
1 Lynch Suppressor, 700 ohms	1.50
1 Durham Metallized Resistor, 6 meg	.50
2 Tait Brackets	2.00
1 Alcoa Aluminum Chassis	7.50
4 Sets Special Aluminum Box Shields for LC-28 @ $2.00	8.00
1 Aluminum Panel, 6"x26"	4.50
1 ⅛" Extension Shaft	.50

READY-TO-WIRE KIT, PRICE $90^{15}

POWER PACK and AUDIO AMPLIFIER

to operate in conjuction with the LC-28 Receiver—in Stock!!

COMPLETE KITS **Magnaformer** 9-8 CIRCUIT IN STOCK

NEW! HAMMARLUND ROBERTS HI-Q SIX

Our New 1928 Catalog Is Now Ready. Send For It NOW!

CORWICO

Radio's Best Wire

"From the Ground Up"

No chain is stronger than its weakest link. That's why the wire you use in your radio set or the wire that is used in the set you buy, is an important factor. Why take a chance, when for the same price and in many cases less, you can have the best by specifying "Corwico" radio wires. Their superior merits and all-around efficiency have been proven by amateurs, experts and radio receiving set manufacturers everywhere.

The next time you need wire for any radio purpose, ask your dealer for "Corwico." If he can't supply you, write us direct.

CORWICO Braidite CORNISH WIRE CO. NEW YORK N.Y.

"Braidite"

To make a soldered connection, it is not necessary with Braidite, to strip back the insulation. The braid is simply pushed back while the soldering is done and then replaced, thus making the neatest possible connection. Made in red, green, yellow, brown and black.

"Corwico" Radio Wires

Antenna Wire (Solid, Stranded and Braided)
Complete Aerial Kits
Magnet Wire
Battery Cable
Bus Bar Wire
Hook-up Wire
Lead-in Wire
Annunciator Wire
Loop Aerial Wire
Litz Wire
Flexible Wire

"Corwico" Radio Wires are sold by all leading dealers. Write for free booklet on radio wires and their uses.

CORNISH WIRE COMPANY
30 CHURCH STREET NEW YORK CITY

S.M. UNIPACKS

KARAS EQUAMATIC

BREMER TULLY COUNTERPHASE SIX

NEW! REMLER INFRA-DYNE

NEW SAMSON POWER PACK

PACENT PHONOVOX

LOFTIN WHITE

Hammarlund ROBERTS HiQ

NEW! LC-28 Complete Parts in stock!

WRS sells the parts exactly as specified by the designers of the circuits. We make no substitutions. Every part in our LC-28 KIT is exactly as used by Mr. Cockaday in his laboratory model.

We have built up a national reputation through our service on kits and special apparatus. By purchasing your kits from WRS you not only assure yourself of the correct discount but save many dollars through delays in obtaining the parts from a dozen different jobbers.

Be sure to write for our new catalog and discount sheet listing the newest and latest circuits, sets and accessories.

WRS is exclusive distributor for the Aluminum Panels for LC-28 circuit. Dealers and Jobbers — Write for proposition.

PARTS FOR ALL LATEST CIRCUITS IN STOCK

Wholesale Radio Service Co.
6 Church Street, New York City

THE following stations were received and logged at the amateur station of Dr. L. Bailleul (F-8EZ), 119 Boulevarde de Belfort, Roubaix (Nord), France, using a single-wire antenna and counterpoise and a Schnell receiver:

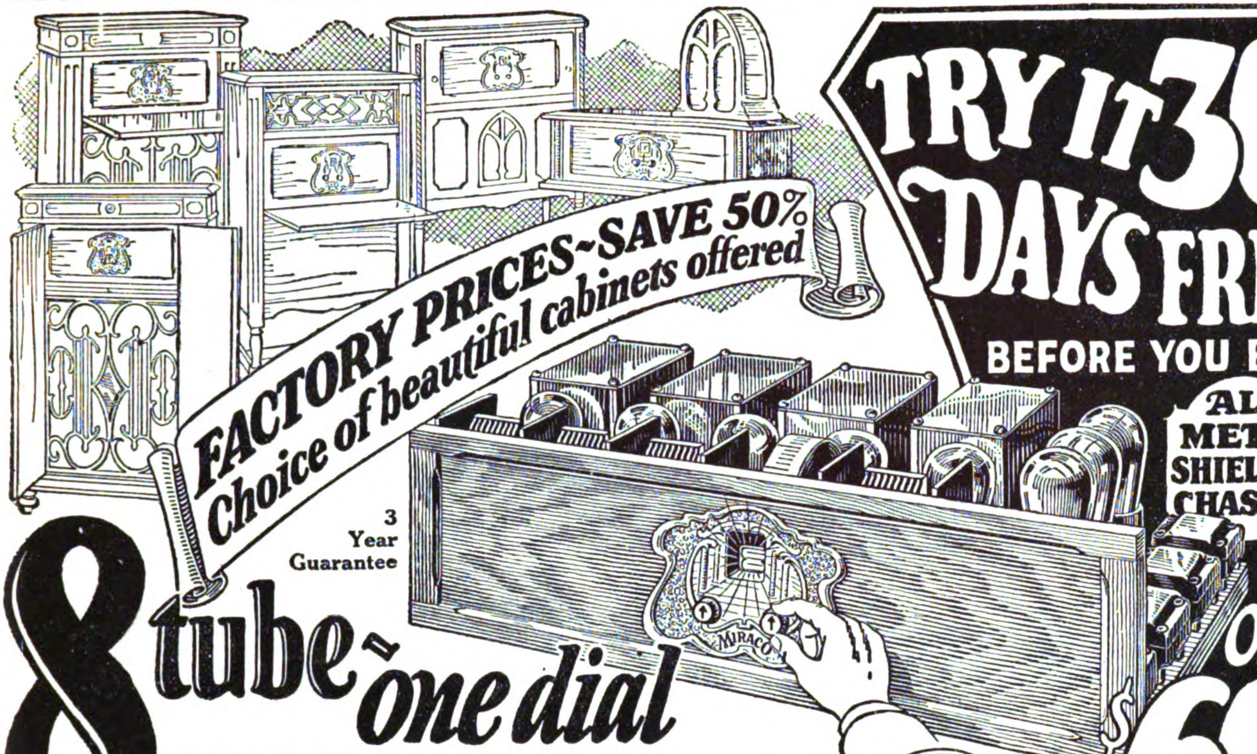
NU-4HY—March 13, 1927; signal strength R7; good rectified AC note; no fading;
NU-8DRJ—March 13, 1927; signal strength R7; good rectified AC note; no fading;
NU-1NQ—March 13, 1927; signal strength R6; good DC note; no fading;
NU-1RF—March 12, 1927; signal strength R7; good DC note; no fading;
NU-4TK—March 14, 1927; signal strength R6; good rectified AC note; no fading;
NU-1AVG—March 14, 1927; signal strength R4; good rectified AC note; much static; no fading;
NU-2CS—March 13, 1927; signal strength R4; good DC note; no fading;
NU-2AG—March 21, 1927; signal strength R6-7; good DC note; atmospherics;
NU-2AHM—March 21, 1927; signal strength R7; poor DC note; very bad interference;
NU-1AKM—March 26, 1927; signal strength R6; good rectified AC note;
NU-2AKJ—March 31, 1927; signal strength R4; good rectified AC note; bad static and interference;
NU-1ON—March 29, 1927; signal strength R3; good rectified AC note;
NU-9CIA—April 7, 1927; signal strength R4-5; good DC note;
NU-5OA—April 7, 1927; signal strength R3-4; rectified AC note, with fading.

THE following stations were received and logged at the amateur station of Paul Gauthier (EF-8PMT), Nancy, France, using a Schnell receiver with a detector and one stage of low frequency:

NU-8AJU—April 16, 1927; signal strength R5; 35 meters; no fading;
NU-2BUY—April 16, 1927; signal strength R6; good note on 30 meters; no fading;
NU-4OC—April 16, 1927; signal strength R5; good note on 31 meters;
NU-3AUV—April 4, 1927; signal strength R6; very good note on 30 meters; no fading;
NU-4SI—April 4, 1927; signal strength R6; 30 meters; no fading;
NU-1ARV—April 4, 1927; signal strength R5; 31 meters; no fading.

The following stations were received and logged at the amateur station EF-8ARO in Belfort, France, using a low-loss receiver with detector and one stage of low frequency, and a double cage antenna:

NU-1RD—April 6, 1927; signal strength R3-5; rectified AC note on 20.5 meters; much static; fading;
NU-1BUX—April 2, 1927; signal strength R4; rectified AC note on 19.5 meters; static and fading;
NU-2AGQ—Feb. 12, 1927; signal strength R3-4; rectified AC note on 21 meters; much static; fading;
NU-4WE—Feb. 22, 1927; signal strength R3; DC note on 20 meters; static and much interference; no fading;
NU-1SW—March 4, 1927; signal strength R6; rectified AC note on 21 meters; much static and interference;
NU-1ADM—Feb. 22, 1927; signal strength R5; DC note on 21 meters; static and fading.


FACTORY PRICES~SAVE 50%
Choice of beautiful cabinets offered
MIRACO

TRY IT 30 DAYS FREE

BEFORE YOU BUY

ALL METAL SHIELDED CHASSIS

3 Year Guarantee

8 tube~one dial

MIRACO

TRADE MARK REGISTERED

Only $69^75

Retail List Completely Assembled

MAGNIFICENT TONE~SUPER SELECTIVE~POWERFUL DISTANCE GETTER

All Electric~or Battery Set!

America's big, old, reliable Radio Corporation* (8th successful year) *guarantees* its big, powerful, latest 6, 7 and 8 tube Miraco sets to give "the finest, most enjoyable performance obtainable in *high grade* radios." Unless 30 days' use in your home fully satisfies you and everybody who hears it that a Miraco is unbeatable at any price for beautiful, clear cathedral tone, razor-edge selectivity, powerful distance reception, easy operation, etc.—*don't buy it! Your verdict final*—absolutely no strings to this. Save or make lots of money on sets and equipment by writing for testimony of nearby users and *Amazing Special Factory Offer.*

Run from Light Socket or Batteries

Miraco's work equally fine on electric house current or with batteries. Take your choice. Many thousands of Miraco users—who bought after thorough comparisons—testify they enjoy programs Coast to Coast, Canada to Mexico, loud and clear—with the magnificent cathedral tone quality of costliest sets. Don't confuse Miraco's with cheap, "squawky" radios. Miraco's have finest parts, latest approved shielding, metal chassis, etc.—as used in $200 sets.

Dealers Write!

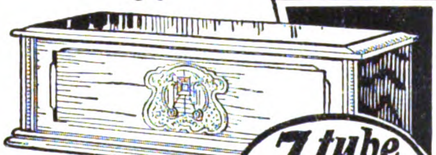
Deal Direct with Big Reliable Makers

Your Miraco reaches you completely assembled, rigidly tested, fully guaranteed. Easy to connect and operate. *30 days free trial.* 3 year guarantee if you buy. Choice of beautiful consoles [with latest built-in orthophonic type speakers having 8 feet of tone travel] and table cabinets, also offered. You take no risk, you insure satisfaction, you enjoy *rock-bottom money-saving prices by* dealing direct with one of radio's oldest, most successful builders of fine sets.

USER-AGENTS! *Make big profits showing your Miraco set to friends*

*MIDWEST RADIO CORPORATION, Cincinnati, O.

Big Discounts to User-Agents



MIRACO "Powerplus" sets—both in 8 and 7 tube models—have magnificently beautiful, clear cathedral tone equality. Turn one dial for stations everywhere. Ultra-selective. Miraco multi-stage distance amplification gives "power-plus" on far-off stations. Latest all-metal shielded chassis. Illuminated dial. Fully guaranteed. *Try one free for 30 days!* Choice of beautiful cabinets.

7 tube one dial

METAL SHIELDED CHASSIS

$49^75

RETAIL LIST

Electrify Any Radio *with* MIDWEST NO-BATTERY "AC" Light Socket Power Units

"A", "B" and "C" power, direct from light socket, without batteries! Write for Midwest prices and discounts. Midwest Units are highest grade—lastingly dependable, quiet in operation, fully guaranteed.

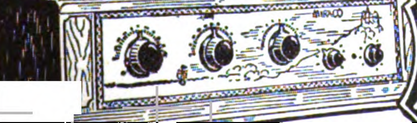
Free!

BEAUTIFULLY ILLUSTRATED
CATALOG AND AMAZING
SPECIAL OFFER

SEND NO MONEY.—30 DAYS' TRIAL
Special Wholesale Price Offer to User-Agents, Bank References and testimony of nearby Miraco users—sent with calalog.

Famous powerful big Miraco Super 6, 1928 model—ultra selective. Thousands find it outperforms and outdistances sets of much higher price.
Fully Guaranteed.

Amazing value as 30 Days' Tria Wi



6 tube Super $36^75 RETAI

Mail Coupon Right Now

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
479-A Miraco Building, Cincinnati, Ohio.

THIS COUPON IS NOT AN ORDER

Without obligation, send free catalog, AMAZING SPECIAL OFFER, testimony of nearby Miraco users.

NAME

Trickle charge or full-rate charge–

You get either or both with

Westinghouse Rectigon

Battery Charger

~~$18.00~~

Now

$14.00

YOUR battery needs two kinds of charging!

Under ordinary conditions, a low-rate charge, "trickled in" during the hours that the set is idle, will keep the battery full of pep. Then, for occasions when prolonged use of the set drains more power than trickle chargers can replace, you need a high-rate charge. The Westinghouse Rectigon gives you *both kinds of charging*. Rectigon charges at a high rate and at a low rate—and it charges wet "B" as well as automobile batteries.

Rectigon is a Westinghouse product—and you know Westinghouse knows radio. Back in 1920, the first program ever broadcast came from radio station KDKA. Rectigon is safe—uses no acids or chemicals. Long-lived, with no moving parts to break or wear out. Does no harm if you tune in while charging, nor if the light company turns off the power while Rectigon is in the circuit. Get away from charging station expense with Rectigon Home Charger. At your dealer's, now $14.00.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA.
Offices in All Principal Cities , *Representatives Everywhere*
Tune in with KDKA—KYW—WBZ

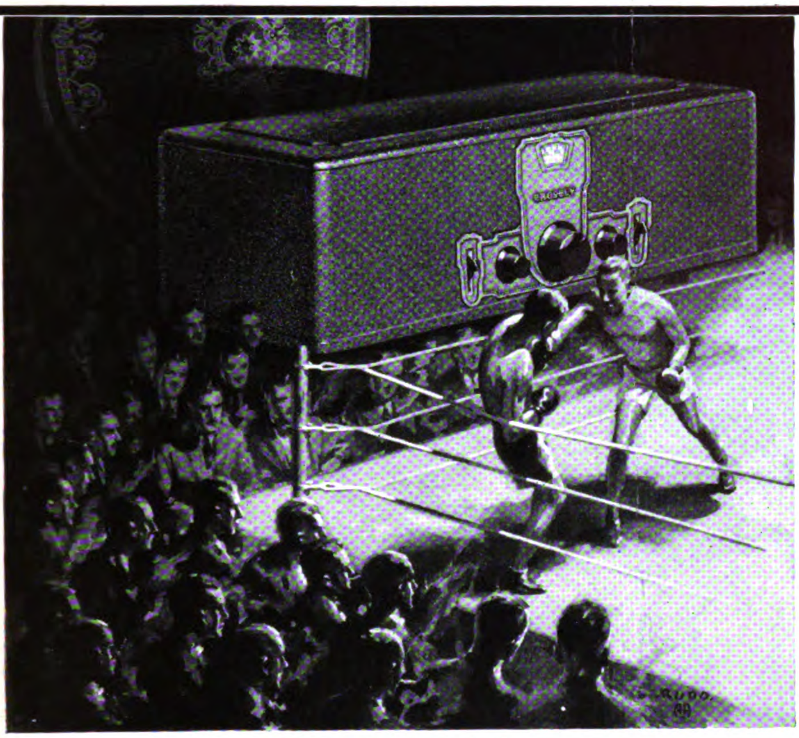
For trickle charging only—the long-lived little Rectox. No guesswork, no acids or chemicals, no trouble. Leave Rectox permanently on charge and replace during "silent hours" the power used during average "operating hours." Two rates of charge—½ ampere and ¾ ampere. At most dealers', $11.50.

See the Westinghouse exhibit of Rectigons, Radio Instruments, and Micarta Radio Panels at the Sixth Annual Radio Show, Coliseum, Chicago, October 10th to 16th, inclusive: Booth 1, Section AA.

W
WESTINGHOUSE ELECTRIC

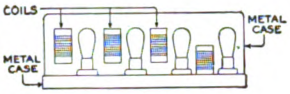
~when the crown stands or falls....

"— You're *there* with a Crosley ..."



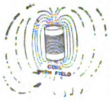
The Crosley Radio Corporation:
Folks who buy radio are vitally interested in what they get for their money. Why don't you radio manufacturers stop talking like a lot of doctors and tell us what it's all about in one cylinder words? What's this "shielding" business anyway?
Yours truly
Belknap Hdwe. & Mfg. Co.
Louisville, Ky.

Shielding is necessary in a modern radio receiver. The more sensitive the set is, the more you need it. Some sets are merely

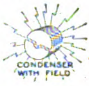


housed in a metal case. This helps to keep strong local signals from breaking through, but it is even more important to keep them where they belong after you get them the proper way from the antenna.

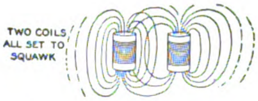
A set has tubes, condensers and coils. Here is a coil. The lines around it are the magnetic field. You know the earth's magnetic field will work a compass down in a mine, or up in a plane (it certainly worked for Lindbergh) and the fields around unshielded coils get all mixed up and the set howls and squeals and has to be choked off by turning down the filaments in the tubes.



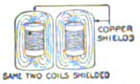
Now if the coils are housed in copper shields the fields can't mess each other up, and the tubes can do a real job of amplifying. The coils in Crosley sets have these copper shields, and there isn't anything better.



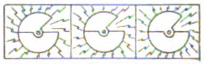
Then there are the condensers, and if it wasn't for the shield around them, the fields would act like those in the coils, and the results would be just as bad, or worse.



It isn't enough to shield the coils and the condensers, because even the wiring of the set has fields around it. This too is shielded, as it is in all really high grade sets.



Of course, it's all in knowing how to do it, but that's why Crosley sets can be as good as the best without costing half as much.



CONDENSERS PROPERLY HOUSED

The BANDBOX

A 6 Tube Receiver *of* unmatchable quality at $55

Many features of this set have been found heretofore only in the most expensive radio. Since Crosley is licensed to manufacture under nearly all important radio patents, this combination with Crosley leadership and experience, naturally produced an amazing radio, the remarkable value of which can be judged by the following features incorporated and by seeing it and hearing it at your dealers.

1. Completely shielded coils, condensers and wiring. 2. Acuminators for sharper tuning. 3. Completely balanced genuine neutrodyne. 4. Volume control. 5. Single tuning knob. 6. Illuminated dial. 7. Single cable outside connections. 8. Designed for easy installation in consoles. 9. Beautiful frosted brown crystalline finished cabinet.

AC model using new R.C.A. AC tubes and working directly from electric light socket through Crosley Power Converter is $65. Power Converter $60 extra.

Hear this wonderful new contribution to the enjoyment of radio. If you cannot find one of the 16,000 Crosley dealers near you, write Dept. 16 for his name and literature.

Crosley is licensed to manufacture under licenses of the Radio Corporation of America and associate companies, also The Hazeltine Corporation and Latour Corporation.

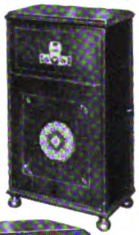
APPROVED CONSOLES

Selected by Powel Crosley, Jr., as ideal, acoustically and mechanically for the installation of the Crosley "Bandbox" Genuine Musicone built in. Crosley dealers secure them from their jobbers through

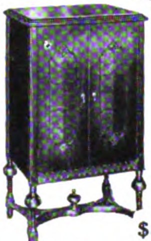
H. T. ROBERTS CO.
914 S. Michigan Ave.,
Chicago, Ill.

Sales Agents for Approved Console Factories

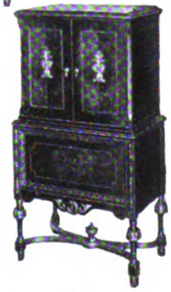
Showers Brothers Co.
The Wolf Mfg. Industries



$35



$65



$85

IMPROVED MUSICONES

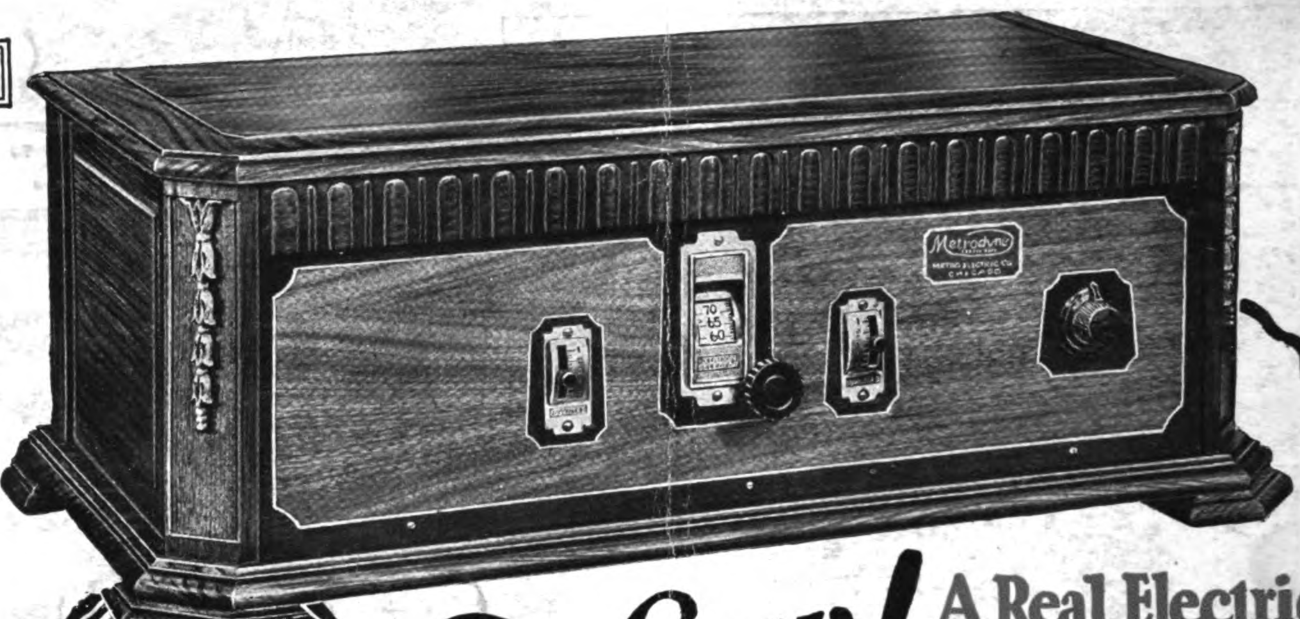
sicones improve reception of any o set. They are fect affinities beauty and reductive effectiveness Crosley Radios. A table model, with n mahogany finstands 36 inches , $27.50—16-inch er-Musicone as tured above with ndbox", $12.75— inch Ultra-Musie $9.75

CROSLEY RADIO

The Crosley Radio Corporation, Powel Crosley, Jr., Pres., Cincinnati, Ohio.

Crosley Radio is licensed only for Radio Amateur, Experimental and Broadcast Reception.

Prices slightly higher west of the Rocky Mountains



Now! A Real Electric Radio Set

Three Year Guarantee

Shipped direct from our factory at rock bottom prices—cost less than most battery sets

No Batteries, Chargers or Eliminators

No Acids; No Liquids—Plug In—Press Button—"Tune In"

30 Days Free Trial

AGENTS! DEALERS! BIG PROFITS!

Make big money taking orders for Metrodynes. All or part time. Metrodyne All Electric Radios are in a class by themselves. Unequalled for quality, performance and price. Demonstrate at home and take orders. Lowest wholesale prices. Your demonstrating set on 30 days' free trial. Mail coupon below for details.

Metrodyne

ALL ELECTRIC RADIO

7 Tubes—Single Dial Set

100% Electric Radio

At last! The radio you've dreamed about! If you have electricity in your home you can now really enjoy **coast to coast** radio reception without the care, bother and muss of batteries, chargers, eliminators, etc. The Metrodyne **All Electric** is a real, genuine **batteryless** radio set. Simply insert the plug in the socket, press the switch button and "tune in." You could not possibly buy a better radio set than the **Metrodyne All Electric**, no matter what price you paid.

BEAUTY—EFFICIENCY DEPENDABILITY

The Metrodyne All Electric Radio is a 7 tube, single dial set. Only the highest quality low loss parts are used throughout. Solid walnut cabinet, beautiful two-tone effect, with handsome gilt metal trimmings. Size of cabinet, 28 inches long, 13 inches deep, 10 inches high. Has electrically lighted dial so that you can log stations in the dark. Only one dial to tune in all stations. Excellent tone qualities — wonderful volume — very selective.

Gorgeous Console Electric Radio

Here is the Metrodyne All Electric Console Radio — a gorgeous, genuine walnut cabinet, in a beautiful two-tone finish. Has a built-in genuine Metro-Cone large size speaker. Brings in programs with great volume, reproducing the entire range from the lowest to the highest notes with remarkable clearness and distinction. All metal parts are finished in old gold. Wonderful electric radio, in a cabinet that will beautify the appearance of any home.

Costs Less Than Most Battery Sets

Do not confuse the Metrodyne electric radio with ordinary light socket sets, because the Metrodyne is truly an **all electric radio** — consumes less than 2c worth of power a day. Comes to you **direct from the factory.** Its low cost brings it down to the price of an ordinary battery set. We are so confident that you will be delighted with this wonderful, easy-to-operate **batteryless radio** that we offer to ship it to your home for **thirty days' free trial** — you to be the judge.

Mail This Coupon

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer,** which gives you the opportunity of trying before buying. Thousands of Metrodynes have been bought on our liberal free trial basis — **WRITE TODAY!**

METRO ELECTRIC COMPANY
2165 N. California Ave. *Dept.* 611 Chicago, Illinois

METRO ELECTRIC COMPANY
2165 N. California Ave., Dept. 611
Chicago, Illinois

Gentlemen:
Send me full particulars about Metrodyne All Electric Radio and your **thirty days' free trial offer.**

Name
Address
If you are interested in AGENT'S proposition place an "X" in the square → ☐

MAIL COUPON NOW!

QUADRI-COLOR CO., JAMAICA, N.Y.C.

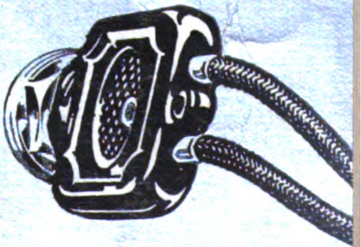
NOV 14 1927

Popular Radio

NOVEMBER · 1927

25¢

How to Build *the* LC-28 Unipac Amplifier *and the* New Hammarlund Hi-Q Receiver



30 DAYS FREE TRIAL

Battery or All-Electric OPERATION

HERE is the great value offer of the day. Test and try this powerful seven-tube RANDOLPH RADIO for thirty days. After it **brings in stations from coast to coast** with amazing clearness—**with easy one-dial tuning**—after it **easily equals any other radio** regardless of cost—after you are more than satisfied then you can buy it **direct at factory prices. Every RANDOLPH must make good before it is sold.**

The RANDOLPH SEVEN-TUBE CONSOLE illustrated here can be had for use with batteries or **connected direct to the electric light socket—absolutely batteryless—no batteries, chargers or acids—just plug in and tune in.** 100% efficient either way. Its construction and performance have been tested and approved by leading radio engineers and authorities—by leading radio publications and laboratories.

7 Tubes—Single Control

Illuminated Drum

One drum dial operated by one simple vernier control tunes in all stations with easy selectivity to tremendous volume. No overlapping of stations. Illuminated drum permits operation in the dark. Volume control for finer volume modulation. This is a seven-tube tuned radio frequency receiver with power transformers and power amplification. Space wound solenoid coils. Full and completely shielded. A real receiver of the highest quality. Tremendous distance, wonderful tone quality, simple to operate.

Beautiful Walnut Console

Built-in Cone Speaker

The Randolph Seven-tube Ampliphonic Console illustrated above is housed in a genuine burl-walnut cabinet with two-tone hand rubbed finish giving it unsurpassed beauty. The same expert cabinet work has gone into the making of these consoles as in the finest furniture. Has **built-in cone loud speaker that compares with any on the market.** Accurately reproduces complete range of musical notes from the highest to the lowest pitch.

What Users Say

I have logged more than 50 stations from coast to coast.—Lloyd Davenport, Littlefield, Texas. I have logged 52 stations from Cuba to Seattle, the set is a world beater.—J. Tampkinson, Detroit, Mich. Your set is a revelation, has all others tied to the post for distance and selectivity.—Waldo Powers, Vergennes, Vermont. On strength of its performance sold two more sets this week.—T. Scanlow, Orlando, Florida.

The **Randolph**
7-Tube Console
Single Control
RETAIL PRICE
Completely Assembled
$99

The Senior Six

Now you can have a new, modern, single-control, six-tube radio. Do not compare this set with old style 2-dial 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers.

Comes in a beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated Drum with space for logging. Absolutely dependable and very selective. **Sent for 30 Days' Free Trial. You test it before you buy.**

6-Tube
$55
Retail Price
Single Control

MAIL COUPON NOW!

The Randolph Radio Corporation are pioneers in the manufacture of radios. All of its vast and unlimited resources have been used in making and perfecting of the Randolph Receivers. Because of our long and successful experience in the radio business, we are perfectly confident in sending out a Randolph Radio on trial. We know what it will do. Mail us the coupon now for the greatest radio offer ever made.

RANDOLPH RADIO CORPORATION
711 West Lake Street **Dept. 253** **Chicago, Illinois**

Sensationally Big Discounts to Agents

Work either full or part time and make big money. Tremendous advertising campaign helps you sell. Regardless of whether you have ever sold before, be sure to get our proposition. The Randolph sells on first demonstration. Men and women both can make money this easy way. Get your demonstration set for thirty day's FREE TRIAL.

Use This Coupon NOW!

Randolph Radio Corporation,
711 West Lake Street, Dept. 228
Chicago, Illinois.

Send me full particulars about the RANDOLPH Six and Seven-Tube All-Electric and Battery Table and Console Sets with details of your **30 Day FREE Trial Offer.**

Name..

Address..

City.. State..............................

Mark here ☐ if interested in Agent's proposition.

... Modern

Here is the Eveready Layerbilt "B" Battery No. 486, Eveready's longest-lasting provider of Battery Power.

Radio is better with *Battery* Power

NOT because they are new in themselves, but because they make possible modern perfection of radio reception, batteries are the modern source of radio power.

Today's radio sets were produced not merely to make something new, but to give you new enjoyment. That they will do. New pleasures await you; more especially if you use Battery Power. Never were receivers so sensitive, loud-speakers so faithful; never has the need been so imperative for pure DC, Direct Current, that batteries provide. You must operate your set with current that is smooth, uniform, steady. Only such current is noiseless, free from disturbing sounds and false tonal effects. And only from batteries can such current be had.

So batteries are needful if you would bring to your home the best that radio has to offer. Choose the Eveready Layerbilt "B" Battery No. 486, modern in construction, developed exclusively by Eveready to bring new life and vigor to an old principle—actually the best and longest-lasting Eveready Battery ever built. It gives you Battery Power for such a long time that you will find the cost and effort of infrequent replacement small indeed beside the modern perfection of reception that Battery Power makes possible.

NATIONAL CARBON CO., INC.
New York UCC San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night —9 P. M., Eastern Standard Time

WEAF—*New York*
WJAR—*Providence*
WEEI—*Boston*
WFI—*Philadelphia*
WGR—*Buffalo*
WCAE—*Pittsburgh*
WSAI—*Cincinnati*
WTAM—*Cleveland*
WWJ—*Detroit*
WGN—*Chicago*
WOC—*Davenport*
WCCO—{ *Minneapolis* / *St. Paul*
KSD—*St. Louis*
WDAF—*Kansas City*
WRC—*Washington*
WGY—*Schenectady*
WHAS—*Louisville*
WSB—*Atlanta*
WSM—*Nashville*
WMC—*Memphis*

Pacific Coast Stations— 9 P. M., Pacific Standard Time

KPO—KGO—*San Francisco*
KFOA—KOMO—*Seattle*
KFI—*Los Angeles*
KGW—*Portland*

EVEREADY
Radio Batteries
—they last longer

The air is full of things you shouldn't miss

Popular Radio

EDITED *by* RAYMOND FRANCIS YATES

FOUNDED 1911

VOLUME XII November, 1927 NUMBER 5

CONTENTS

A Radio "Still" that Evaporates Steel
FRONTISPIECE..........PAGE 310

Roxy's Absorbing Theory of "Radio Psychology"
America's outstanding broadcaster tells the secret of his astonishing success
By "Roxy" (S. L. Rothafel)...PAGE 311

The Hammarlund Hi-Q "Six"
Constructional details for a receiver with an improved system of "cascaded" high-frequency amplification
By Raymond Francis Yates....PAGE 314

AC Rejuvenation for the Radiola 20
By Charles L. Davis.......PAGE 318

Forced and Free Vibrations
The principles of the celebrated "N" circuit, as told by one of radio's foremost pioneers—
Sir Oliver Lodge, F.R.S., D.Sc., LL.D....PAGE 319

A Radio that Plays Watchman
By Walter E. Burton......PAGE 322

How to Build the LC-28 Unipac Amplifier
A compact unit that furnishes low-frequency amplification and "B" and "C" power for the LC-28 high-frequency pack
By Laurence M. Cockaday....PAGE 324

A Measurement Chart
A mathematical time-saver for the experimenter and set builder
By Raoul J. Hoffman, A.M.E...PAGE 327

A Circuit New in Principle and Performance—The Octa-monic
"Harmonic" detection gives amazing results in this latest advance in circuit design
By John Brennan........PAGE 328

How to Build the MagnaRay Power-Pack
A snappy "B" power unit for use with the Magnaformer 9-8 receiver
By Laurence M. Cockaday....PAGE 330

The New High-mu 2-Grid Valve
By L. James..........PAGE 332

The Phono-Radio Reproducer
No. 4 of a series of articles on combining radio and the phonograph for all-round program reproduction
By James Millen........PAGE 334

What's New in Radio
By the Technical Staff......PAGE 338

How to Read the Autobiographies of Vacuum Valves
By H. A. McIlvaine, E.E....PAGE 342

How to Build and Operate the Universal Tester
Experimenters and service men will find countless uses for this radio "detective"
By Morris M. Silver......PAGE 346

The New Belin Televisor......PAGE 347

How to Build the Lynch "Five" Receiver
A receiver of unique quality—within the reach of every man's pocketbook
By S. Gordon Taylor......PAGE 348

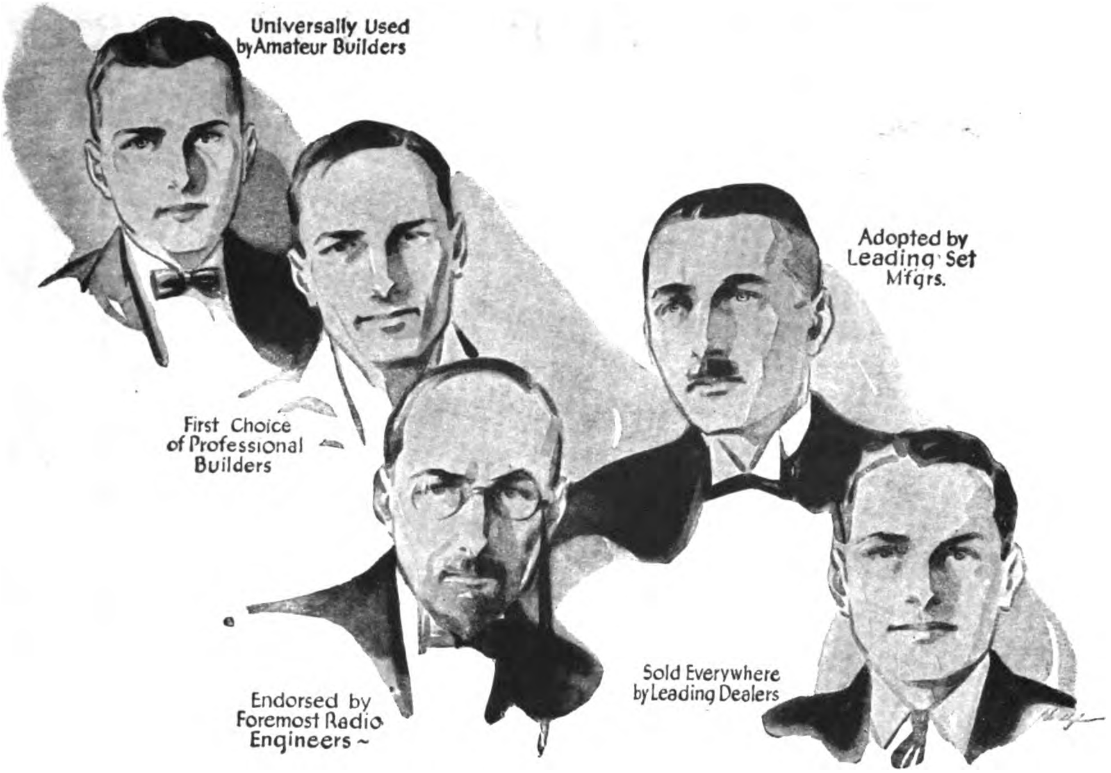
DEPARTMENTS

Broadcast Listener ....*Raymond Francis Yates*.. 366
With the Experimenters..........*S. Gordon Taylor*........ 382

VOLUME XII NOVEMBER, 1927 NUMBER 5

Published monthly by Popular Radio, Inc., 119 West 57th St., New York, N. Y.; telephone number, Circle 8180; Douglas H. Cooke, President and Treasurer; Laurence M. Cockaday, Secretary; Emma A. Harm, Asst. Treasurer. Price, 25 cents a copy; subscription, $3.00 a year in the U. S., Canada and all countries within the domestic postal zone; elsewhere, $3.50 a year, payable in advance. The International News Company, Ltd., No. 5 Bream's Bldg., London, E. C. 4, sole distributors in England. Entered as second-class matter April 7, 1922, at the Post Office at New York, N. Y. under the act of March 3, 1879. Additional entry at Jamaica, L. I., N. Y. Copyright 1927, and title registered as a trade-mark by Popular Radio, Inc. Copyright in Great Britain by Popular Radio, Inc., 6 Henrietta St., Covent Garden, W. C., London, England. *For advertising rates, address* Popular Radio, Inc., 119 West 57th St., New York; or 225 North Michigan Ave., Chicago.
Printed in U. S. A.

LAURENCE M. COCKADAY, *Technical Editor*
CHARLES L. DAVIS, *Managing Editor* E. E. FREE, Ph.D., *Contributing Editor*


Universally Used by Amateur Builders
Adopted by Leading Set Mfgrs.
First Choice of Professional Builders
Sold Everywhere by Leading Dealers
Endorsed by Foremost Radio Engineers ~

FIRST CHOICE
of the Keenest Minds in Radio!

Durham standard resistors are made in ranges from 500 ohms to 10 megohms. Durham Powerohms for "B" Eliminators and Amplifier circuits are made in 2.5 watt and 5 watt sizes in ranges from 500 to 100,000 ohms.

FIRST CHOICE—because Durham was the first and original "metallized filament" resistor—because years of heavy production and the confidence of leading radio manufacturers have given us *time* to produce a perfect product.

Durham Resistors and Powerohms are the leaders in their field because their uniform, unfailing accuracy and absolute reliability have been proved time and time again.

This is why they are the first choice of foremost engineers, leading manufacturers, professional set builders and informed radio fans who demand quality results.

Like Durham Resistors and Powerohms, Durham Resistor Mountings are also the leaders in their field. The only upright mountings made; takes minimum space—made of high resistance moulded insulation—best quality tension-spring bronze contacts. Single and double sizes.

Adopted by Leading Radio Manufacturers

Philco
A-C Dayton
F.A.D. Andrea
Western Electric
Sterling Mfg. Co.
Kellogg Switchboard
Garod Radio Corp.
Fansteel Balkite
Kokomo Electric
Howard Radio
Browning-Drake

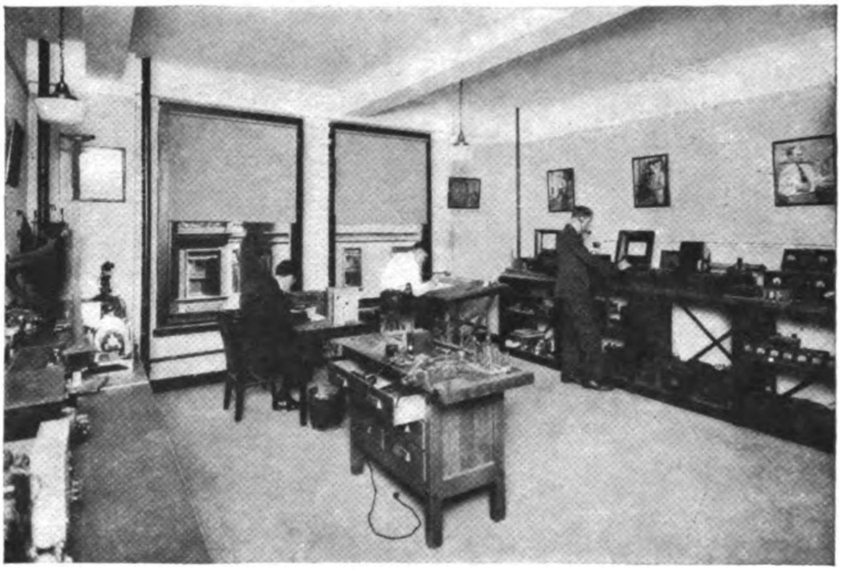
SPECIFIED FOR THE KNICKERBOCKER 4 and KARAS EQUAMATIC

DURHAM
METALLIZED

RESISTORS & POWEROHMS

INTERNATIONAL RESISTANCE CO., Dept. A, 2½ South 20th Street, Philadelphia, Pa.

A PAGE WITH THE EDITOR



From a photograph made for POPULAR RADIO

POPULAR RADIO'S SPACIOUS NEW LABORATORY

The new POPULAR RADIO *Laboratory is one of the most modern institutions of its kind in this country and is far the most commodiously equipped in the publishing field. Not only has the Laboratory new headquarters, but many new instruments as well. The Laboratory is located in the executive offices of the publishers at 119 West 57th Street, New York, N. Y.*

THIS particular number of POPULAR RADIO is issued from the spic-and-span new headquarters at 119 West 57th Street, opposite Carnegie Hall. The new quarters afford greater space, more convenient accessibility and ideal conditions for the functioning of the publication's many departments. Nothing but growth and expansion necessitated the change.

* *

IT might be said that the latch-string cordially dangles from the door for those of our friends who were accustomed to calling at the old address.

* *

STILL the letters are filtering in from readers who wish to express their satisfaction with phonograph pick-up units used in connection with good low-frequency amplifiers. It seems as though POPULAR RADIO's active campaign to interest readers in this wonderful new device has borne luscious fruit. Incidentally, one manufacturer of pick-up devices has frankly confessed his inability to keep pace with the demand that this publication has created for these units.

* *

MANY of those who do not contemplate the construction of new instruments are planning to modernize their old sets by installing new low-frequency equipment. All of which reminds us of a statement recently made by a radio engineer of national fame. Said he: "It's been years since I shaved with a straight razor, and I can't understand those people who still insist on using antiquated low-frequency apparatus when the new stuff is so easily installed and the results so deliciously entertaining."

* *

POPULAR RADIO has in store a wealth of new and interesting editorial material and several exceptionally absorbing articles all planned for the Christmas Number. Christmas comes but once a year, you know, and the editor will put forth every effort to make Santa Claus anything but parsimonious. Chief among the feature articles will be "The Radio Mystery House" which, incidentally, is not fiction. It is a—well, just a mystery.

* *

THERE is still another important forecast for December. In this issue POPULAR RADIO will hit another high mark with the details of an A. C. operated superheterodyne of simple construction. Of all of the "wows" that P. R. has printed, this is one of the "wowest."

* *

As these paragraphs are being written, a great wave of interest in set building is sweeping across the continent, and radio enthusiasts everywhere are scraping the rust from their tools in preparation for an active winter of receiver construction. The crop forecast for good receivers appears very encouraging, indeed.

LAWRENCE B. BATSON of the Department of Commerce comes forward with some absorbing figures showing that over 90,000,000 people throughout the civilized world are now listeners to radio programs. He further states that some 18,000,000 sets are in use and that 200,000,000 sets would be required to service the populace of this unimportant little planet of ours.

* *

WHERE, oh, where, Dear Mr. Radio Statistics Man, are those gloomy brothers who talk so pessimistically about saturation? Saturation of what, the radio manufacturer's pocketbook?

* *

ALONG with this talk about saturation, it's interesting to note that the Homeland is the largest exporter of radio equipment in the world. Canada is our best customer, with Argentina second. Evidently we don't have to tell the world where to shop for the best apparatus obtainable.

* *

THIS recalls to mind a remark made by an appreciative English visitor to our own laboratory. "Our British Engineers," he said, "are still dreaming of the things that you Americans are doing."

Raymond F. Yates

ARCTURIZE YOUR RADIO

Now you can have all the convenience and economy of A-C operation — plus unfailing *reception of unusual tone quality with the* reliable

ARCTURUS A-C TUBES

With but a few simple changes in wiring, you can modernize the radio receiver you now own. The only A-C Tube on the market with but four prongs, the Arcturus A-C Tube fits present sockets, can be installed in any circuit without the addition of condensers, or potentiometers.

The changeover to Arcturus A-C Tubes does not take long or cost much. The uniform quality reception they give you is your assurance of complete satisfaction.

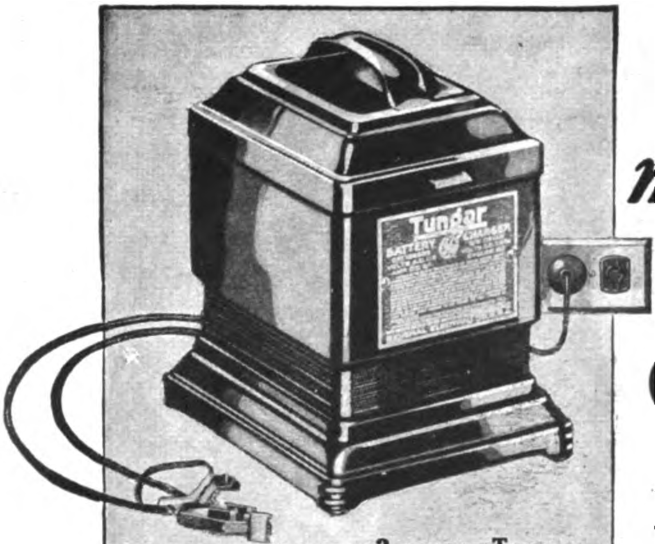
For Your New Set

When you are selecting a fine, new set, make sure that you will reap all the benefits of A-C operation, the absolute reliability, convenience and economy that can be yours only with Arcturus A-C Tubes.

ARCTURUS RADIO COMPANY
INCORPORATED
257 Sherman Avenue, Newark, N. J.

Battery Chargers *made and guaranteed by* General Electric

now $10 - $14 - $24



2-ampere Tungar

5-ampere Tungar

G-E Trickle Charger

New Low Prices

(East of the Rockies)

2-ampere Tungar . .	now $14
5-ampere Tungar . .	now $24
G-E Trickle Charger .	now $10

Tungar causes no radio interference. It cannot blow out tubes.

An overnight charge costs about a dime.

It is a G-E product developed in the Research Laboratories of General Electric.

The 2- or 5-ampere Tungars charge 2-, 4- and 6-volt "A" batteries, 24- to 96-volt "B" batteries in series; and auto batteries, too. No extra attachments needed.

When you buy a General Electric battery charger for your radio batteries, you get a thoroughly tested and proved product.

The Tungar [the name of the General Electric battery charger] was developed by a staff of technical experts in the experimental and testing laboratories of the world's greatest electrical organization.

More than 1,000,000 Tungars are in use today. For Tungar long ago established its reputation for dependable, trouble-free, economical service.

Just turn on a Tungar at night . . . in the morning your radio storage batteries are pepped up and ready for active duty.

Your dealer can help you. Ask him to show you the popular 2-ampere Tungar that gives both trickle and boost charging rates. It charges "A" and "B" radio batteries and auto batteries, too.

GE Tungar REG. U.S. PAT. OFF. BATTERY CHARGER

Merchandise Department
General Electric Company
Bridgeport, Connecticut

Tungar—a registered trademark —is found only on the genuine. Look for it on the name plate.

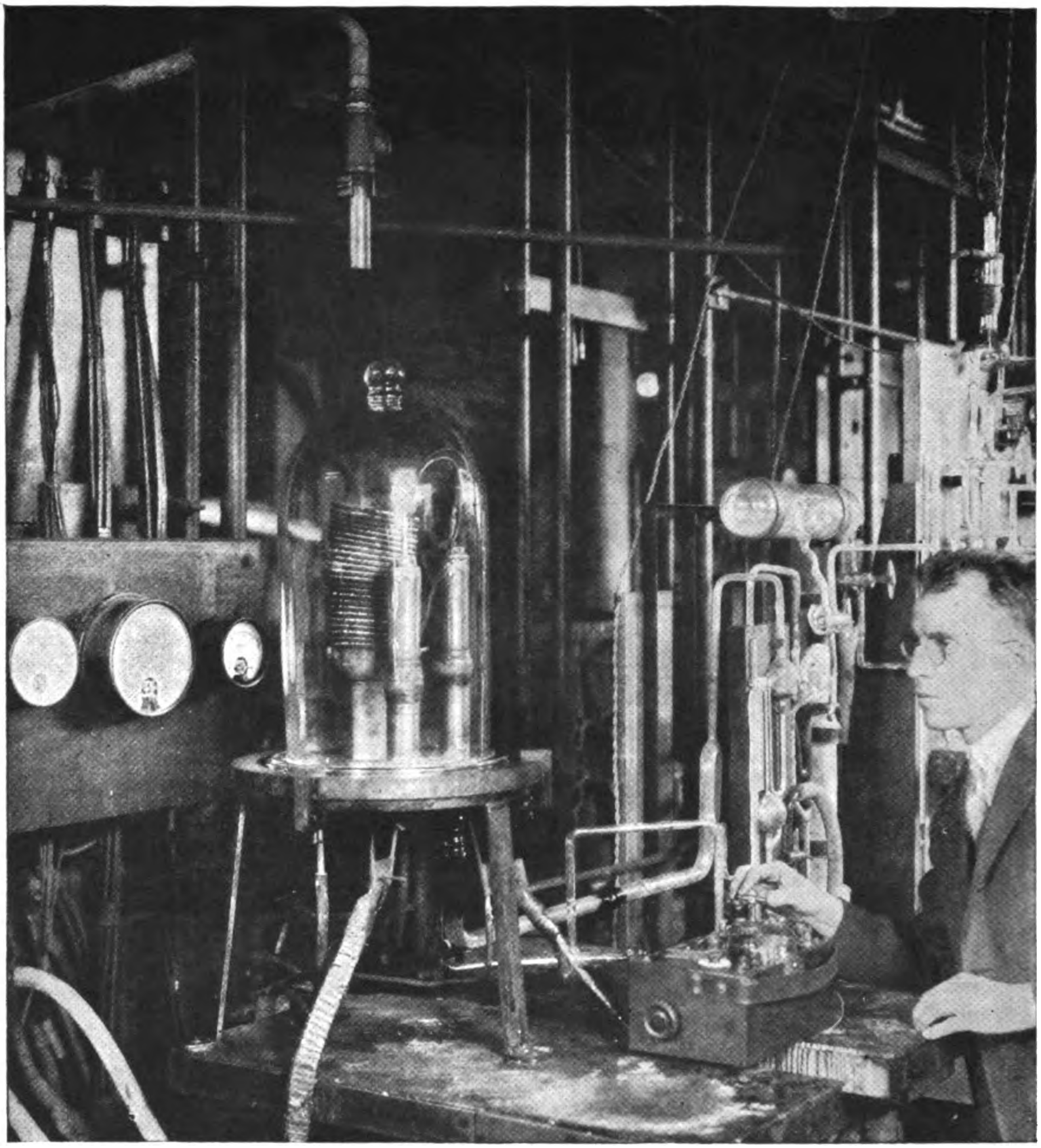
GENERAL ELECTRIC

POPULAR RADIO Keeps Its Readers "One Step Ahead of the Other Fellow"

"The value of POPULAR RADIO *is above par to the man who strives to be a little better acquainted with the latest and the best circuits. Technical information upon various radio subjects—especially reception—has always been presented in such an interesting way that the home builder feels that he should apply this knowledge to his own set; as a result, he produces a receiver which is the nearest to perfection in tone quality. With* POPULAR RADIO *as a guide, he is well equipped to follow the rapid radio improvements and is enabled to be one step ahead of the other fellow."*

Henry F. Heins

PRESIDENT, HEINS & BOLET, INC.



Westinghouse

A Radio "Still" That Evaporates Steel

Heat so great that steel and the noble metals evaporate as readily as alcohol in a still is generated in this high-frequency vacuum furnace, which utilizes the same electric currents as those employed in radio communication. Current of a frequency corresponding to a wavelength of ten thousand meters is sent through the coil inside the glass vacuum bell, creating a heavy oscillating magnetic field. If a metal is placed within the coil, so that it absorbs most of this energy, the frenzied atoms generate such frictional heat in responding to the changing magnetic field that the metal is liquefied and gasified in less time than it will take the reader to absorb the contents of this caption. P. H. Brace, of the Westinghouse Research Laboratory, is shown with the apparatus.

Popular Radio

VOLUME XII November, 1927 NUMBER 5

ROXY'S ABSORBING THEORY OF

"RADIO PSYCHOLOGY"

Radio's greatest humanist and impresario tells how mass psychology knits the radio audience together and causes it to establish its own fancies and ideals, to which every successful broadcaster must appeal. Listeners automatically elect to popularity only those who are able to interpret their commonplace reactions to entertaining stimuli. Roxy says "Yes" to the question, "Is there an immutable psychological law that makes the radio audience always right in its choice of broadcast programs?"

By "ROXY"

(S. L. ROTHAFEL)

IF you have watched a flock of birds in flight, you will be better able to understand my attempt to explain what I believe to be the sound psychology of broadcasting—I might even say the "law of broadcasting." Birds in flight, it seems, obey some unexplainable law of mass suggestion which causes them to veer to the right or left, to dip or ascend, with perfectly unified and coordinated action. It is an uncanny sight to see thousands of our winged friends responding with delicate precision to this invisible, intangible "something" that makes its appeal only to their psychic selves.

In a measure, the radio audience responds to the work of its willing impresarios in much the same way as the birds respond to mass suggestion. There is a common, sympathetic understanding between its various members and there is a common response to the same stimuli. And I'll tell you that I had to do a lot of broadcasting to find this out. For months after I began my work on the air, I worried and fretted over a plan whereby I might better understand the mood of the radio audience. It was like looking for the Philosopher's Stone of Radio: something that would make all hearts akin.

What was needed was an appeal that would knit the emotions of the audience together, and cause it to express itself as a unit. A universal stimulus had to be found that would win mass approval. To guide me, I had formulated a more or less roughly hewn idea of the functioning of the mind of the theatre-goer, but I feared that a knowledge of the psychology of the theatre was unavailable for use on the air. In the theatre you reach the mind of your audience through two channels, the eye and the ear. On the air, you must reach out for emotional response through the ear alone.

The problem solved itself. After my first "gang" had appeared regularly for several weeks, mail began to sweep down on us in tremendous volume. Had I unknowingly struck the very thing that I was trying to find? Had I unwittingly found a means of tapping that psychic stuff that makes the birds fly in unison? Further experience proved that I had.

What was this secret of the air, if secret it could be called? It was sentiment. No matter what the philosophers tell you, I believe that when all is said and done it's sentiment that makes the whole world akin. If you can touch people's hearts, you've got them. Why? I don't know, but since the time when I was knocking about as a cash boy in a Fourteenth Street department store it's been my experience.

Why did the radio public become so entranced with "Gamby" and "Doug"? I'll tell you: because "mike" told the world, the whole wide world, about their love affair, and brought the romance of a charming ballerina and her handsome troubadour right to the humdrum fireside of the listeners-in.

It wasn't dignified, you may say, but what has dignity to do with merriment? Aren't we all children at heart, anyway? On our birthdays don't we put on paper caps and hope to get the prize out of the frosted cake, just as we did when we were kids? Well, anyway, I do.

I get a tremendous kick out of the morning's mail after a broadcasting session. It's just like a big surprise bag to me. Just as "mike" reflects your own personality, whether you like it or not, so does the radio mail reflect unerringly the opinion of the public. Well, no, it isn't always complimentary, but that doesn't matter. You can soon learn to boost yourself by the knocks, if you are determined to profit by your mistakes. Many an idea has come to me through a radio letter. Many a constructive criticism, too. They have a way of saying exactly what they think, these listeners-in, and, believe me, it is not only a revelation of the public's mind, but an inspiration to "carry on."

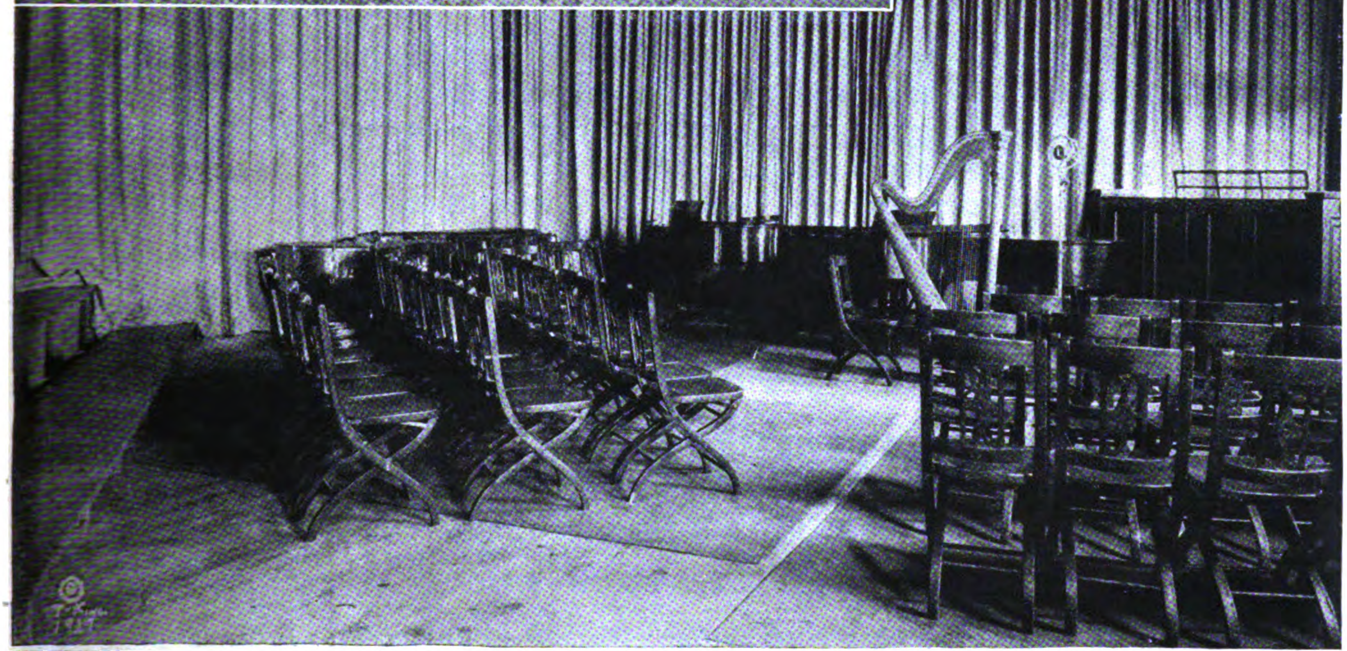
The controlling microphone of a chain of modern broadcasting stations such as we use in our weekly broadcasts is to-day a most powerful instrument for affecting mass psychology, providing a broadcaster has some inkling of the more subtle reactions of his listeners. Louis Satow, the psychologist, comments learnedly on this phenomenon in one of his books. "Many of the ideas and conceptions," says Satow, "which the individual believes himself to have adopted independently and without constraint, are no more than the effect of the mass mind which manifests itself in manners, customs, and education. On the other hand, the individual mind, especially that of the leader or moralist, has a stimulating effect upon the mind of the crowd."

Unless you are a more eloquent orator than I, however, you cannot get the crowd to follow you in becoming enthusiastic about something that it is only mildly interested in. I'm not a Theodore Roosevelt or a Plato; I don't attempt to change opinions already formed. Sentiment was born with the race and it is appealed to perhaps more easily than any other human characteristic. When you strike at sentiment,

Roxy Masters the Baton as Well as the Microphone

Although not able to read music, Roxy directs his symphony orchestra with a genius that amazes the connoisseurs. His baton anticipates every note and he demonstrates an enormous capacity for memorizing the classics. Musicians who play under his direction say that they absorb just as much inspiration from him as they do under the guidance of directors of greater experience. When in the mood, Roxy often directs the great 110-piece symphony orchestra of the Roxy Theatre, in New York.

At the left is Roxy in an informal pose, snapped on his estate at Spuyten Duyvil, New York. The picture below shows the broadcasting studio of the new Roxy Theatre. The studio is large enough to accommodate a sixty-piece symphony, together with the hundred-voice Russian chorus. It is provided with a glass enclosed balcony from which visitors may view the microphone performers at their work.



Tebbs & Knell

you are striking at something very fundamental.

I choose sentimental appeal for my programs and I have persisted in this, for once an impresario has hit a responsive note he must stick to it.

There is such a thing as suggestive compulsion, although I would not use it if I could, because I do not need to convince my audience. It already cries for the things that reach the heart; the things that temper life; the things that offer it even momentary escape from this materialistic life that is closing in on us more and more every day.

I must confess that I am a very sentimental person. This is really fortunate, since it does not make it necessary for me to humbug my way into the heart of my audience. Here again we deal with another phenomena of mass radio psychology—the imitative instinct, which, to quote an authority, "is innate in man and causes the crowd to play a much greater susceptibility to suggestion than the individual." Bechterow says somewhere in his voluminous writings on the subject that "without really knowing it, we reach a certain level where we acquire for ourselves the emotions, superstitious ideas, opinions, tendencies, intentions, and even singularities of character of the individuals with whom we most commonly associate."

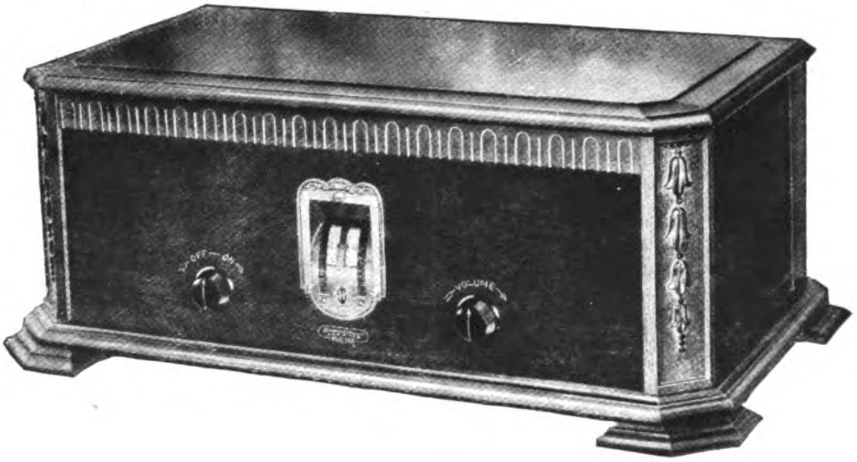
Mass psychology will make men see red or white, it will make them love or hate, and in the radio we have one of the greatest instruments for use in making life more bearable and comfortable. My own programs try to emphasize the silvery side of things—try to make men and women see white, so to speak.

It's odd how, at times, we go wide of the mark in attempting to broadcast what we think should prove the most acceptable feature. Some of the numbers that are considered perfect bring in a distinctly hostile mail, and others that are considered doubtful bring in inspiring floods of approbation.

For a long time I was very doubtful as to the effect that poor Gamby would make with her little ditties, although she was very sincere about their rendition. I conferred with my most faithful associates and friends and a decision was reached to see what the effect would be of taking her off the air. The effect was nothing short of thunderous, and Gamby was quickly put back on the program to stay. Here was an interesting study in radio psychology that I was at a loss to understand, but it accounted for a potential following, a following that, by its sheer force of numbers, made a singer out of a dancer.

Upstairs in our theatre we have stored away over one million letters from radio fans, and I should indeed like to turn them over to the Psychology Department of some college that they might be carefully tabulated and studied. I think this might give us an entirely new insight into broadcasting. It would, I feel sure, vindicate my pol-

(Continued on page 353)



TO RADIO BUILDERS EVERYWHERE:

The new model of the Hammarlund Hi-Q Receiver is the result of eleven months of painstaking research, and represents the honest effort of its designers to supply set builders with all that is modern and efficient in radio design. The splendid performance of the receiver has been more than commensurate with its cost, and I firmly believe that the new Hi-Q takes its place beside the best that 1928 engineering will have to offer.

—LLOYD HAMMARLUND

Hi Quality, Hi Amplification and Hi Efficiency—

The Hammarlund Hi-Q "Six"

By RAYMOND FRANCIS YATES

COST OF PARTS—*Not over* $96.00

HERE IS A LIST OF INSTRUMENTS AND ACCESSORIES FOR BUILDING THIS RECEIVER—

A—Samson symphonic transformer;
B—Samson 3-1 transformer, type HW-A-3;
C1, C2, C3 and C4—Hammarlund Midline variable condensers, .0005 mfd.;
D1, D2, D3 and D4—Hammarlund autocouple coils, HQ-64;
E1, E2, E3 and E4—Hammarlund chokes, type RFC-85;
F—Hammarlund illuminated drum dial;
G—Sangamo mica fixed condenser, .00025 mfd.;
H—Sangamo mica fixed condenser, .001 mfd.;
I—Sangamo grid-leak clips;
J—Carter Imp rheostat, 6 ohms, type 1-R-6;
K—Carter Imp battery switch, type 2-A;
L—Durham metallized resistor, 2 megohms;
M2, M3 and M4—Acme Parvolt by-pass condensers, .5 mfd., series A;
N1, N2, N3, N4, N5 and N6—Benjamin Cle-ra-tone, vibrationless sockets, No. 9040;
O1, O2 and O3—Eby engraved binding posts, marked *Speaker plus, Speaker minus* and *Antenna,* respectively;
P1 and P2—Amperite automatic filament adjusters, No. 1-A;
P3—Amperite automatic filament adjuster, No. 112;
Q—Yaxley cable connector and cable, No. 660;
R—Hi-Q "6" foundation unit, containing:
  R1—Drilled and engraved Micarta bakelite panel, 7 by 21 by 1/8 inch;
  R2—Drilled metal chassis;
  R3 and R4—Two-stage aluminum box shields;
  R5 and R6—Brass extension shafts for variable condensers;
  R7 and R8—Cam-operating assemblies;
  R9, R10 and R11—Grid-biasing resistors;
  R12 and R14—Grid suppressors (black);
  R13—Grid suppressor (red);
  R15—Bakelite grid-leak mounting block;
  R16—Bakelite binding-post strip;
Wires, screws, nuts, washers, spacing collars, etc.

IN the last issue of POPULAR RADIO the salient features of the new Hi-Q "Six" were enumerated for the benefit of the radio set-builder and experimenter. The conditions of design were outlined for a receiver that would have adequate selectivity for modern broadcast conditions and, at the same time, satisfy the requirements of uniform amplification and realistic broadcast reception.

The set comprises three stages of tuned-high-frequency amplification, with a tuned detector stage, and with a filter choke and condenser in the output of the detector circuit to exclude high-frequency currents from the low-frequency amplifier. The latter is composed of two stages of transformer-coupled amplification, using the highest quality apparatus and a power valve for reproducing the full scale of musical frequencies.

The outstanding features incorporated in this new receiver are here reviewed:

1. The entire receiver is mounted on a metal chassis with complete shielding for the four tuned circuits that comprise three stages of efficient high-frequency amplification and a detector stage.

2. The mechanical details of the new receiver have been worked out with a view to securing not only efficient operation, but a front panel layout that is

¶ *The list of parts given on page 314 includes the exact instruments used in the laboratory model of this receiver. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instrument. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers,* POPULAR RADIO SERVICE BUREAU, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*

---

pleasing in appearance. The only tuning control appearing on the front panel is an illuminated drum dial, consisting of two separate controls which are, however, turned simultaneously by two fingers of one hand. Only two secondary adjustments appear on the front panel, the filament switch and the volume control.

3. An important feature employed is automatic variable coupling, a new idea in radio, which secures maximum and uniform amplification over the entire tuning range and exceptional selectivity and sensitivity with full volume on all frequencies, without the slightest possibility of oscillation.

4. Another feature of the set is the complete isolation of each of the four tuned circuits by means of chokes and by-pass condensers. This means that each stage operates independently and at highest efficiency without interaction between any of the successive stages.

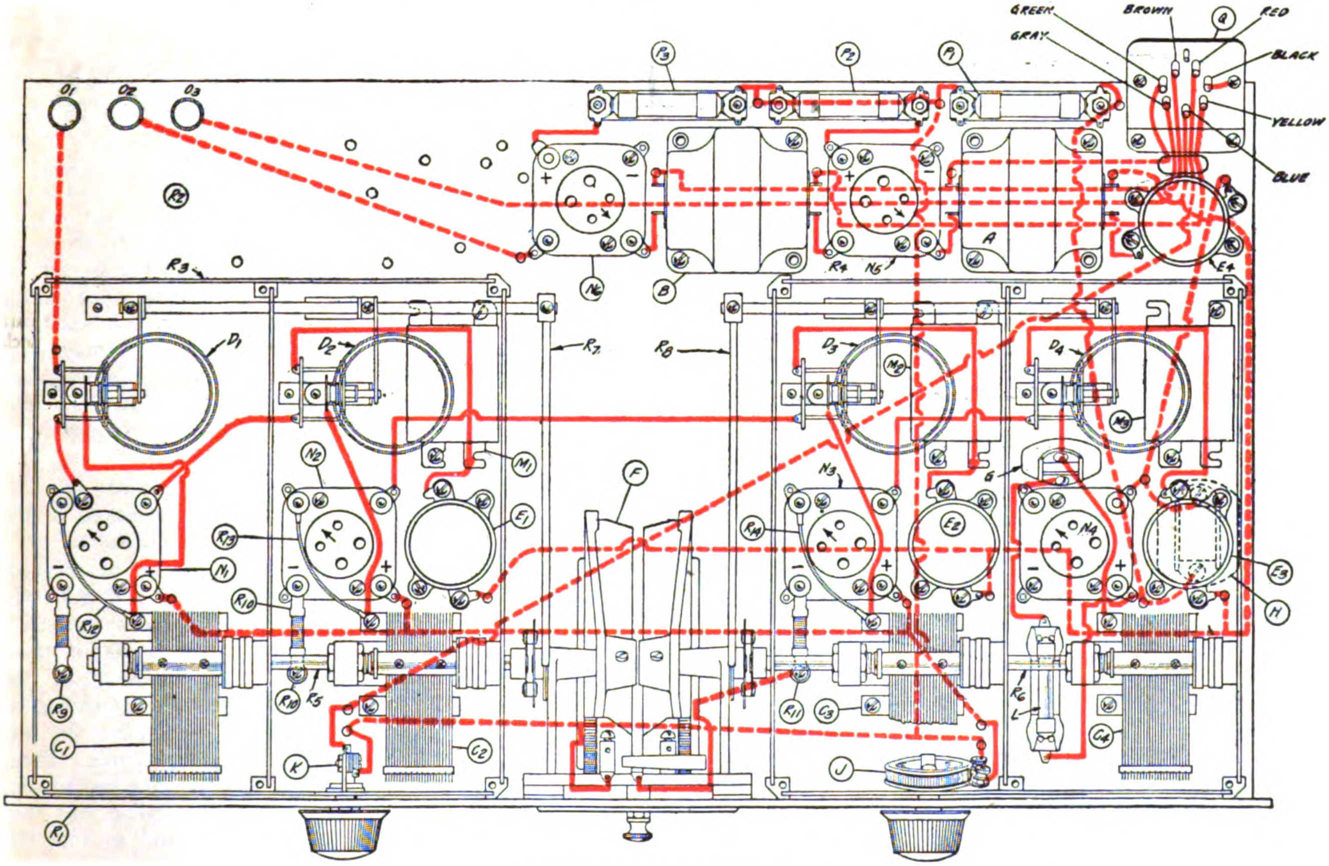
Furthermore, the construction of the set is so simple, and the wiring laid out in such an orderly manner, that anyone without previous radio experience can build it successfully from the diagrams and description given in this article.

How to Assemble the Instruments

The first job to perform is the mounting of the various instruments on the metal chassis. Reference to Figures 1, 2 and 3 will make the description perfectly clear. It will be advisable first to mount the six sockets, N1, N2, N3, N4, N5, N6, taking care to arrange them so that the arrows are in the position shown in Figure 1. Sockets N1, N2 and N3 are mounted with two machine screws and nuts; sockets N4, N5, and N6 have the negative filament binding posts removed and have the machine screw inserted through the hole and through the spacing collars, with the nut on the bottom side of the metal chassis, R2. This connects the negative filament terminal in firm electrical contact with the metal chassis. These latter three sockets also have two machine screws and nuts holding them in position in the normal mounting holes.

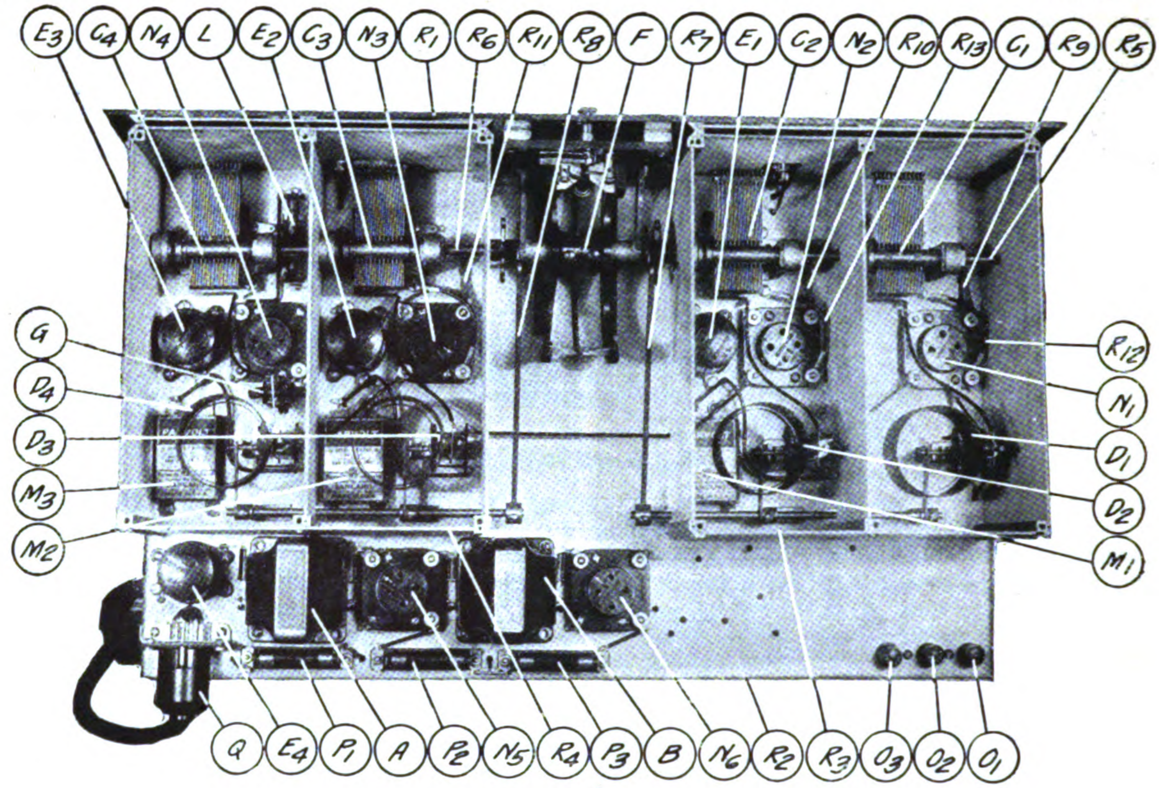
Next attach one end of each of the three grid-biasing resistors, R9, R10, R11, to the negative filament terminals of sockets N1, N2 and N3, respectively. The other ends of the three resistors are connected directly to the metal chassis, R2, by means of a machine screw and nut.

Next attach the Sangamo grid-leak clips to the grid-leak mounting block, R15, by means of machine screws. This should be attached to the chassis next to the socket N4, in the position



HOW TO WIRE THE SET

FIGURE 1: *All the outlines of the instruments and parts are shown in solid* BLACK *lines, except in the case of condenser H, which is shown in dotted* BLACK *lines, to indicate that it is mounted underneath the chassis. The wiring that is run above the chassis is shown in solid* RED *lines, while the wires that run underneath the chassis are shown in dotted* RED *lines. The plug, Q, is shown tilted to expose the contact points.*

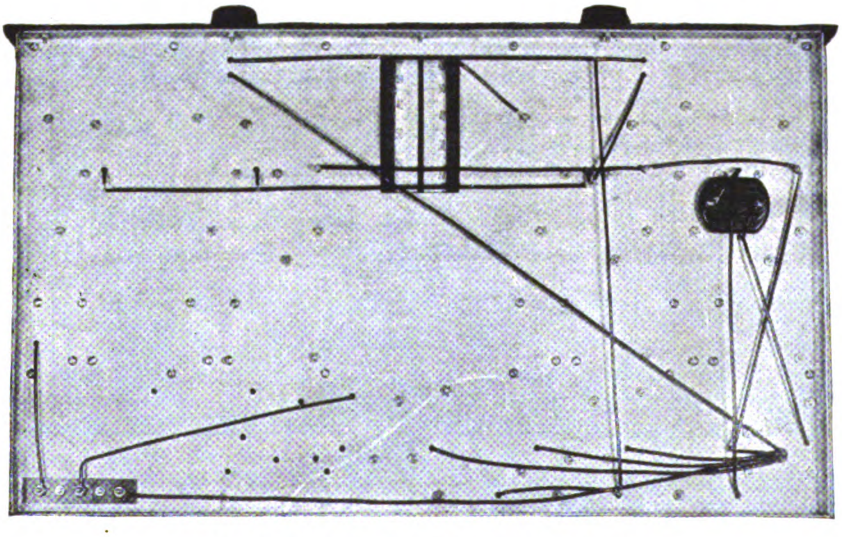


A VIEW OF THE RECEIVER FROM ABOVE

FIGURE 2: *In this picture the general arrangement of all of the instruments and binding posts is clearly indicated. The position of the drum dial and the method of attaching the side walls of the shielding boxes is also shown.*

shown in Figure 1. Insert the grid-leak, L.

Now mount the three by-pass condensers, M2, M3, and M4, by means of a machine screw and nut through one of the mounting lugs, and a machine screw and nut inserted through one left-hand electrical terminal lug, using a ⅛-inch spacing collar under the lug to make efficient electrical contact with the chassis, R2.



THE UNDER SIDE OF THE HI-Q "SIX"

FIGURE 3: *This view of the receiver gives some idea of the simplicity of the wiring and the method of mounting instruments by means of machine screws fastened through the metal chassis.*

This completed, mount the four chokes, E1, E2, E3 and E4, by means of two screws and nuts fastened through the chassis. You are now ready to mount the binding post strip, R16, in position underneath the metal chassis by means of two machine screws and nuts. The three binding posts may then be mounted on the top side of the binding-post strip.

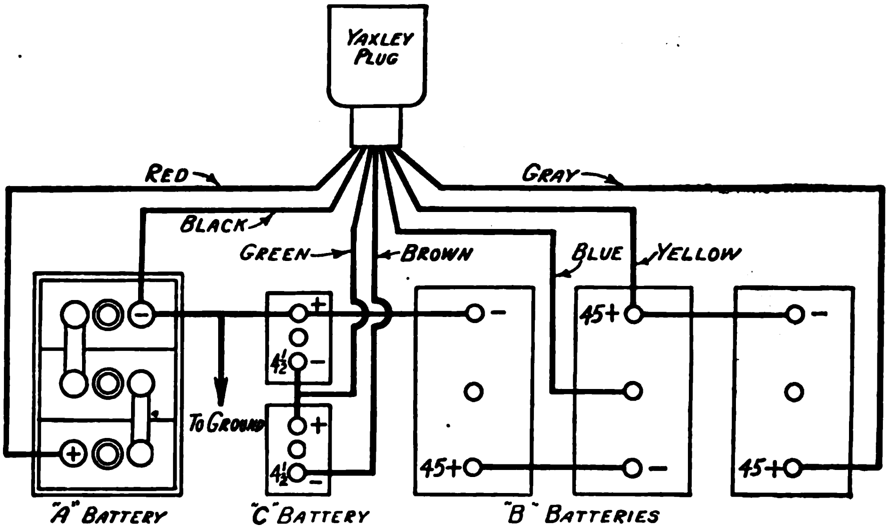
Now mount the three amperites, P1, P2 and P3, and the cable connector, Q, along the back edge of the chassis as shown in Figure 2.

Next mount the four variable condensers, C1, C2, C3 and C4, with one machine screw from the under side of the chassis, in the position shown in Figure 1, so that the condensers mesh upwards and towards the back of the set. Before assembling, the shafts of the condensers should be removed, as well as the single-hole mounting nut and the two mounting screws. The friction band should be loosened, or taken off entirely.

The four auto-couple coils, D1, D2, D3 and D4, are now mounted in the positions indicated in Figure 1.

The four brass brackets of the cam operating-assemblies, R7 and R8, may now be fastened in a similar manner.

Then the 3/16-inch shafts of these assemblies can be inserted in the brackets, at the same time threading on the slotted arms which move the primaries of the auto-couple coils. These slotted arms should be attached so that the slots engage the sliding rod that moves the primaries, and so that the set screws which hold them to the 3/16-inch shafts are uppermost. The two slotted arms on each of the 3/16-inch shafts should be secured at the same angle, so that the primaries of the two coils they control are held in line.



THE BATTERY HOOK-UP DIAGRAM

FIGURE 4: *When the colored leads of the Yaxley cable have been connected to the batteries indicated in this diagram, and the cable inserted in the plug on the sub-panel, the receiver is ready for operation at the turn of the switch.*

The work proceeds with the mounting of the transformers, A and B, with their terminals turned as shown in Figure 1.

This completes the assembly of the chassis, R2, as far as should be done at this time, and the mounting of the instruments on the front panel, R1, should be begun.

First mount the switch, K, and the rheostat, J, in the two holes drilled for them, as shown in Figure 1. These are single-hole mounted and are attached by a single nut. Attach the two small knobs and adjust the pointers.

Now mount the dial, F, according to instructions packed with the dial, and as shown in Figure 1. We are now ready to start the wiring.

How to Wire the Receiver

The wiring of the receiver should be done exactly as shown in the picture wiring diagram in Figure 1.

First attach as much of the wiring as possible on the under side of the chassis, and then wire up the connections between the terminals and the instruments on the top side of the chassis, referring constantly to the picture wiring diagram for these connections. The holes in the chassis are indicated in the picture wiring diagram for wires that run through the chassis at various points. The wires that connect to the switch, K, and the rheostat, J, should be soldered to the terminals of these two instruments before the front panel is attached to the chassis. These wires may then be inserted through the four holes in the chassis and then the front panel may be fastened to the chassis by means of five flat-head machine screws and nuts. After this the wires may be connected to the proper parts of the circuit, as shown in Figure 1.

The three grid suppressors, R12, R13 and R14, should be connected in their proper places as shown in Figure 1, between the stator or variable condensers C1, C2, and C3, and the grid terminals of sockets N1, N2 and N3, respectively, being sure that the *red* suppressor, R13, is placed in the second stage.

The grid condenser, G, is supported by the wiring and is mounted as shown in Figure 2. The mica fixed condenser, H, is mounted underneath the chassis, as shown in Figure 3. Be sure that the metal parts of the condenser, H, *do not touch the chassis.*

The pilot light of the drum dial should be connected in the circuit by two wires, as shown in Figure 1.

When the wiring is complete, the eight aluminum corner posts for the shields should be attached to the chassis with machine screws inserted through the chassis and threaded into the posts.

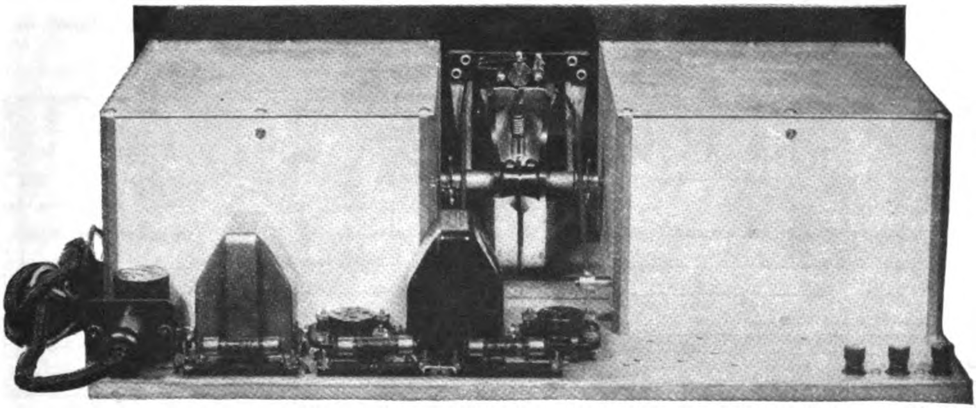
Next attach the four partition posts, one of them to each front and each back shield section, by means of two machine screws. The two front sections and the two back sections of the shield may then be slid in place in the proper grooves in the corner posts.

Now slide in the two extension shafts, R5 and R6, through the two sets of condensers, C1, C2, C3 and C4, and attach to the adjacent ends of the flexible couplings on the drum dial, F. These are held rigidly by two set screws on each of the coupling bushings.

The builder should now be ready to set the two sections of the drum dial at 100 and set the condenser plates *all the way in,* and tighten up on the two set screws in the rotor of each of the variable condensers.

Insert the six side sections of the

(*Continued on page 374*)



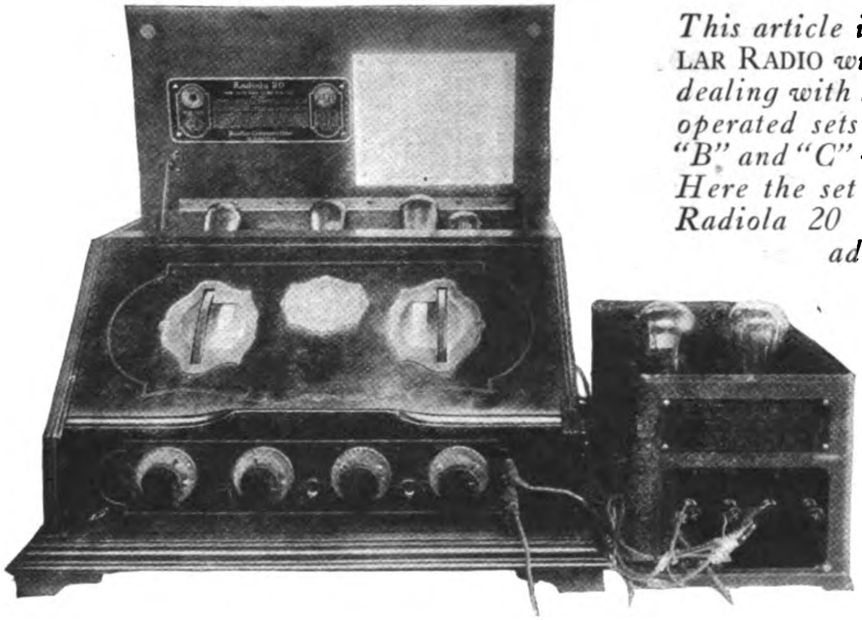
A REAR VIEW OF THE SET

FIGURE 5: *In this view the shields are in place with the top covers screwed down. Note that the low-frequency amplifier, consisting of two stages of high-quality amplification, is mounted exterior to the shields that contain the high-frequency amplifying parts.*

AC Rejuvenation for *The* RADIOLA 20

This article is the first of a series that POPULAR RADIO *will publish from month to month dealing with the conversion of the old battery-operated sets into sets that obtain their "A," "B" and "C" voltages from the lighting mains. Here the set owner is told how to bring his Radiola 20 up to the minute by a slight additional expenditure.*

By CHARLES L. DAVIS



READY FOR LIGHT-SOCKET OPERATION

FIGURE 1: *This picture shows the Radiola 20 and the Powerizer ready for operation at the turn of a switch. AC valves have been installed and all batteries eliminated.*

THERE are several general rules that should be followed in changing a receiver designed for operation with battery-operated valves so as to enable it to get its "A", "B" and "C" power from the lighting lines.

The old filament wiring will have to be revised to take care of the greater heating currents and, in cases where volume has been controlled through filament rheostats, a new volume control will have to be installed.

The first commercial receiver that has been revamped is the Radiola 20, shown in Figure 1. This has been converted into a complete batteryless set by the use of three Ceco type M-26 AC valves and one Ceco type M-27 AC valve operating with a power-pack especially designed for this purpose and manufactured by the Radio Receptor Co. The power-pack itself contains a rectifier valve and a UX-210 power amplifier valve for the last stage of low-frequency amplification.

Special adapter sockets are furnished with the power-pack for holding the new valves. These are completely wired for attaching to the set, and are furnished with complete cables that connect between the power-pack and the set itself.

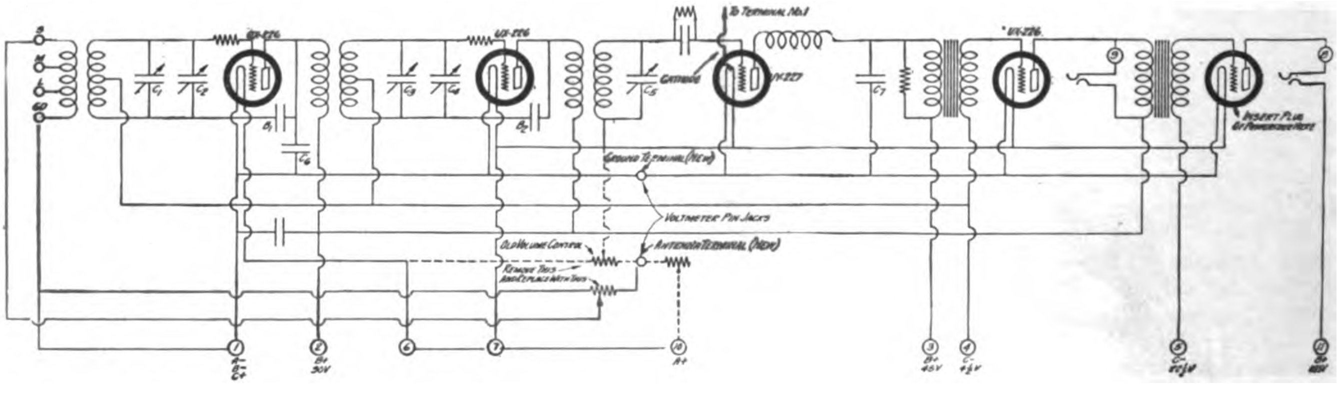
In Figure 3 is shown the top view of the receiver after the changes have been made. Notice that in the third socket a plug is inserted. This plug connects to the amplifier valve of the power-pack.

In the wiring diagram in Figure 2 the original circuit of the receiver is given with the new additions shown in blue. Wires that are to be taken out are shown in dotted black lines. The receiver should be taken from its cabinet before the changes are made.

After the wiring has been changed according to this diagram, the AC valves should be placed in position and the power-pack connected up. All the terminals to the connection cords are marked so that they may be readily attached without fear of error.

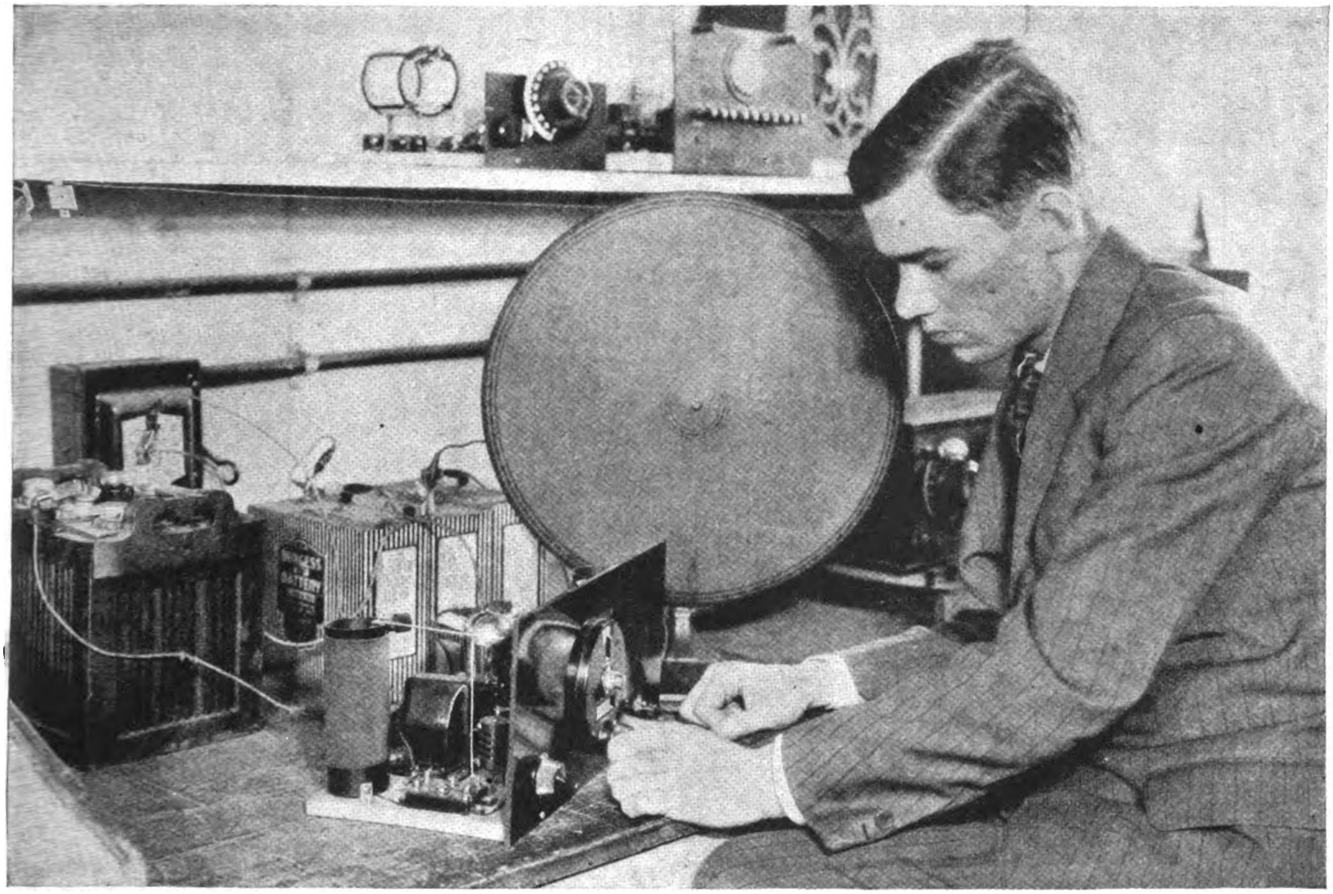
No batteries are necessary once the changes have been made, and the set

(*Continued on page 352*)



THE SCHEMATIC CIRCUIT SHOWING CHANGES AND ADDITIONS

FIGURE 2: *In this schematic wiring diagram for the Radiola 20 the extra wiring and added parts are shown in* BLUE. *The parts of the original wiring that have been eliminated are shown in dotted* BLACK *lines.*



From a photograph made for POPULAR RADIO

THE "N" CIRCUIT AS DEVELOPED FOR AMERICAN USE WITH AMERICAN PARTS

This small receiver incorporating Sir Oliver Lodge's "N" circuit was designed with the use of American apparatus by A. J. Haynes. It is sensitive, selective, easy to operate, and it employs a multiple vacuum valve.

Forced and Free Vibrations

From the principles here described, the author develops the theory of his famous "N" circuit as a free oscillator of exceptional selectivity.

By SIR OLIVER LODGE, F.R.S., D.Sc., LL.D.

ANY closed circuit that possesses inductance and capacity in series is a free vibrator, if there is nothing else near it.

A free vibrator is one which has a definite frequency of its own and is not coupled to anything; it cannot give continuous vibrations, for there is nothing to maintain it.

Once a free vibrator is excited, and then left to itself, like a plucked string or struck tuning-fork, and the vibrations gradually die away. They would be plotted as a sinuous curve of diminishing amplitude, the amplitude of the vibrations diminishing logarithmically or exponentially.

The resistance of an electrical oscillating circuit only affects the frequency in a subordinate manner; the main effect of resistance or damping is on the amplitude or extent of the wave train; this may be measured either by the maximum potential to which the capacity rises, or by the maximum current through the circuit. The average current through such a circuit is practically zero unless it is rectified, for the positive and negative phases are opposite and almost equal.

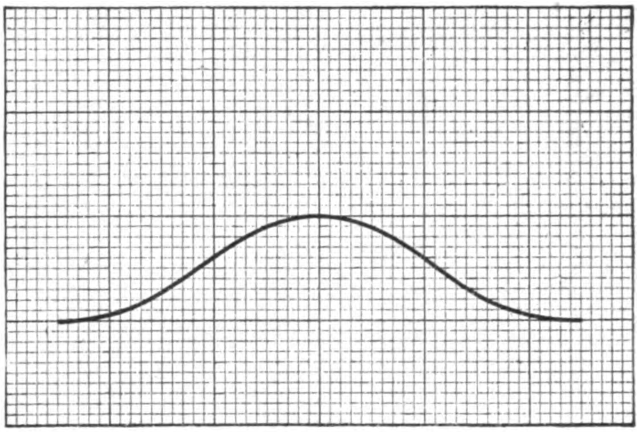
A hot wire in such a circuit does not measure the average current, but the RMS value of current, which is independent of sign. Such a circuit can be used as a wavemeter if the resistance of the hot wire is not too great.

As soon as any circuit is tightly coupled up to something which is going to excite it, it is no longer a free vibrator; its vibrations are forced.

The difference between forced and free vibrations is important.

A radio receiving circuit is always a case of forced vibrations, and the amplitude of the oscillations excited in it depends on the accuracy of tuning and the resistance of the circuit.

Anything may be forced to vibrate by a sufficiently violent stimulus, irrespective of tuning. Provided the friction is small enough, a child might be able to set a church bell ringing by timing its impulses properly, though it would take him some time to work it up; an elephant might set it swinging by a single pull. Similarly a strong singer is said to be able to shatter a pane of glass or a bowl by accurately singing the note corresponding to the free vibration of that glass; a charge of dynamite could



A CURVE ILLUSTRATING BROAD TUNING

This curve, which consists of amplitude plotted against frequency, gives a graphic illustration of a circuit that responds to a broad band of frequencies, due to damping from electrical resistance incorporated in the circuit.

shatter it without any adaptation. No receiver can be immune from a forced vibration of sufficient amplitude; but even if the vibration is continued for a long time, the response of an untuned vibrator will be only feeble. An equation can be written for a vibrator of any period or frequency excited by a forced vibration of some other period or frequency; and it would be found that unless they were in tune the effect would be small. The ultimate rate of vibration would depend not at all on the free rate, but on the forced rate; the discrepancy between the rates would merely keep the amplitude small.

When the tuning is improved, so that the two vibrators are nearly of the same pitch, a curious phenomenon happens at first. The free vibrator tries to vibrate in its own period, and does so until those vibrations have died away and the forced vibration takes control. During that period the two frequencies are superposed, and we get a kind of incipient heterodyning and beats are produced. In a short time, however, the forced vibrations become dominant, and we then get a response of a certain amplitude. Improve the tuning still further, and the amplitude increases greatly in strength. The two are now in agreement. This is experienced during the operation of tuning in. The beats die away and disappear; the tone becomes smooth and continuous, with an amplitude depending on the resistance, or rather the conductance, of the circuit.

If the circuit is of low resistance, there is hardly any limit to the amplitude of the vibrations that can be thus produced when the tuning is perfect.

If the forced vibrations have the frequency p, and the free vibrations the frequency n, the resulting amplitude, when there is no resistance, is a definite fraction of E (the amplitude of the original disturbance), divided by $n^2—p^2$. So that when n and p are in agreement, the resulting amplitude is infinite. This, of course, in practice is not possible, for there must be some resistance. By making the resonating circuit a good conductor, however, its amplitude may be made almost as big as we please.

When two circuits are coupled together, neither of them are free. They interfere with each other more or less, and the combination cannot attain the energy of a really free vibrator.

To get big amplitudes in reception, therefore, the right plan is to use a circuit of low resistance, and arrange so that it shall be disturbed by the forced vibrations coming from a distant station in only a gentle or slight manner. However feeble the received disturbances are, they can be worked up to almost any amount, by resonance, in such a circuit; then they can overflow and give the desired signal through a coherer or valve or any other detector. The detector should not be in the circuit itself, but rather an appendage to it, so as not to interfere with the circuit until it responds, as the resistance of the detector circuit is, up to that time, practically infinite.

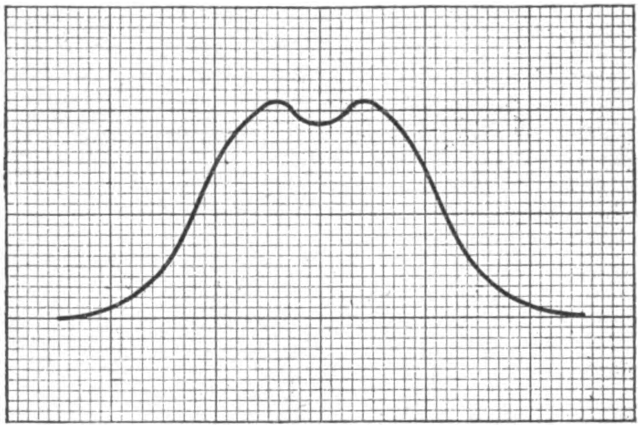
All this, it is needless to say, takes place in a minute fraction of a second with the rapid oscillations used in radio broadcasting.

Moreover, if such a circuit receives vibrations of many frequencies from different stations, being stimulated in this feeble manner by all, it will only respond to the one to which it is itself in tune. The others will be discarded or eliminated. Such a circuit acts as an admitter or responder to vibrations of one frequency and as an ignorer of all others.

If we use a circuit of large capacity and small inductance, it is analogous to a light pendulum or violin string which can easily respond to any disturbance, though it responds more fully to some than to others. But if instead of being a light thing, like a string or a wooden bob pendulum, it is a massive thing like a tuning fork or a pendulum with a heavy lead bob, then it will not be disturbed appreciably by anything except a synchronized disturbance of exactly the right frequency. The electrical analogy to big inertia and great stiffness is a *circuit of high inductance and small capacity.*

Such a circuit responds just as freely as any other to a periodic disturbance of exactly the right pitch, but takes no notice of those with wrong pitch. Such a circuit I will call an "N circuit."

An N circuit is one of high inductance, low capacity and resistance as small as it can be made, and it is to be stimulated by very feeble disturbances collected from the ether and communicated to it by the slightest connection possible. It is to be left almost free from the aerial;



ANOTHER CONDITION OF BROAD TUNING

This curve, plotted in the same manner as the one shown at the top of the page, illustrates the resonance curve of a coupled resonator that has a double amplitude maximum, owing to reaction between forced and free vibrations.

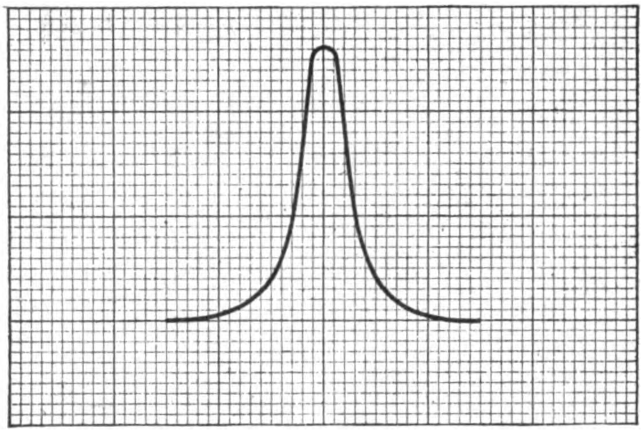
it must be connected to it to some degree or it would not respond at all, but the slighter the connection the better. It is not to be coupled up in any ordinary way. Coupling, in fact, is to be avoided.

A single-wire connection, with a small capacity interposed, suffices to join the N circuit to the aerial.

The aerial should have no tune of its own, so that it can pick up any ether waves which exist. They are all equally transmitted, in the feeble manner described, towards but not to the N circuit; for it takes no notice of any of them except those of the right frequency, and to that particular kind it vigorously responds. The detectors are set into action by the oscillations thus worked up in the N circuit, and are not themselves connected to the aerial at all. The aerial is a mere collector; the N circuit is the responder.

After that come the detector, rectifier, magnifier and telephone arrangements as usual.

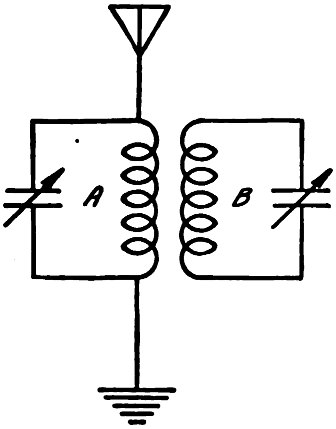
By this means one particular station may be listened to, while all the others are ignored. The tuning, however, has to be precise, so that the received stimulus shall always act in one direction and shall never oppose or destroy what it has begun to excite. The only limit to the selective response thus obtainable is that created by the resistance of the circuit.



A CURVE ILLUSTRATING SHARP TUNING

This curve illustrates a resonating circuit that responds to only a narrow band of frequencies. However, the tuning curve may be made too sharp for good reproduction, so that the best results in selectivity are limited by the best results in tone quality.

It was shown by Kammerlingh Onnes that at a low temperature, approaching that of absolute zero, the resistance of metals became nothing. Some day I feel sure that an experimenter will immerse his receiving circuit in liquid hydrogen or helium, and thereby get a response far beyond anything which has as yet been attained. But such a method might not be good for reproduction, which requires a certain breadth of frequency. The lateral frequencies would be too much excluded if the resonating circuit were too sharply tuned. Meanwhile a device has come into use that has practically the effect of abolishing the resistance of a responding circuit, though at the same time it does not leave it as completely free as it should be. This is the device called regeneration. It cannot be applied with a crystal; but it can be applied by a tube, where the high-tension battery introduces fresh local energy into the circuit, so that the plate part of the circuit is vibrating in a forced manner with extra amplitude due to the introduced energy. These enhanced vibrations are usually made to react upon the input circuit, which is usually a tuned collector. This regenerative action sets up the extra stimulated vibrations of the same frequency as those received, and often causes the bad effect of howling. A circuit can, in fact, be made to excite itself in this way; just as a telephone speaking to its own microphone transmitter can set up a howl. The slightest initial disturbance is magnified by reaction or regeneration between the telephone and the transmitter; its own sound, however feeble, operates the mouthpiece, and thereby increases the response of the telephone, which again reacts on the mouthpiece by feeding back energy—and so on, until the disturbance is worked up.



INDUCTIVELY - COUPLED CIRCUITS

This diagram shows an ordinary coupled resonating circuit in which B is forced to vibrate at the same frequency as A.

When a circuit is thus on the verge of regeneration, it is exceedingly sensitive—almost, though not quite, as sensitive as a receiving circuit cooled to near absolute zero. In using regeneration the object of the experimenter should be to bring the circuit near to the sensitive condition, but not to over-pass it so as to get self-excitation. For self-excitation is a nuisance to all stations in the vicinity, since the self-excited howl cannot be tuned out if one is trying to receive signals on that particular wavelength.

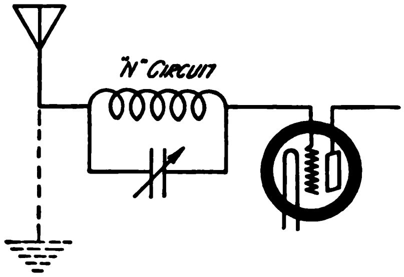
To cure this there should be no radiation at all from the antenna circuit. Whatever regeneration there is should act upon the tube input circuit only. The antenna should not be in tune with it, and, moreover, it should be so feebly connected that it has no temptation to respond.

The antenna circuit must have *some* frequency of its own, since it is a conductor connecting two capacity areas, one the antenna, the other the ground; but if it is thoroughly out of tune, so as to respond let us say only to much longer waves, it will be stimulated only by forced vibrations, which, being of wrong frequency, produce hardly any amplitude of vibration. There is then no effective reradiation; the antenna is not acting as a transmitter.

This result is attained by an antenna circuit entirely out of tune and feebly connected to the circuit which it can excite only by continued vibrations of exactly the right frequency. In other words, the desired waves can be received only by the resonating circuit.

If the forced vibrations received by the antenna are exceedingly strong, as for instance those from a lightning flash in the neighborhood or some powerful station, it will not be possible

(*Continued on page 353*)



A FREE VIBRATOR

This drawing shows a free oscillating circuit incorporating the principles of "N" circuit. It is stimulated by an antenna system, which may or may not be grounded.

A Radio That Plays Watchman

Radio, that needs neither sleep nor vacation, is now doing guard duty that once required the services of several men, without any of the many errors incidental to the "human equation."

By WALTER E. BURTON

A RADIO watchman has been standing guard over the 20,000,000 gallon daily water supply of a quarter million people for nearly two years.

During this period it has made an hourly record, over a distance of fourteen miles and at great saving of expense and labor, of the water level in the reservoir which holds that city's reserve supply of water. Upon this hourly record the operation of a city's pumping station depends. It is important that this hourly record be rendered without fail; otherwise a shortage or excess of water supply would develop that would certainly involve cost and likely involve danger.

But the radio watchman has not failed.

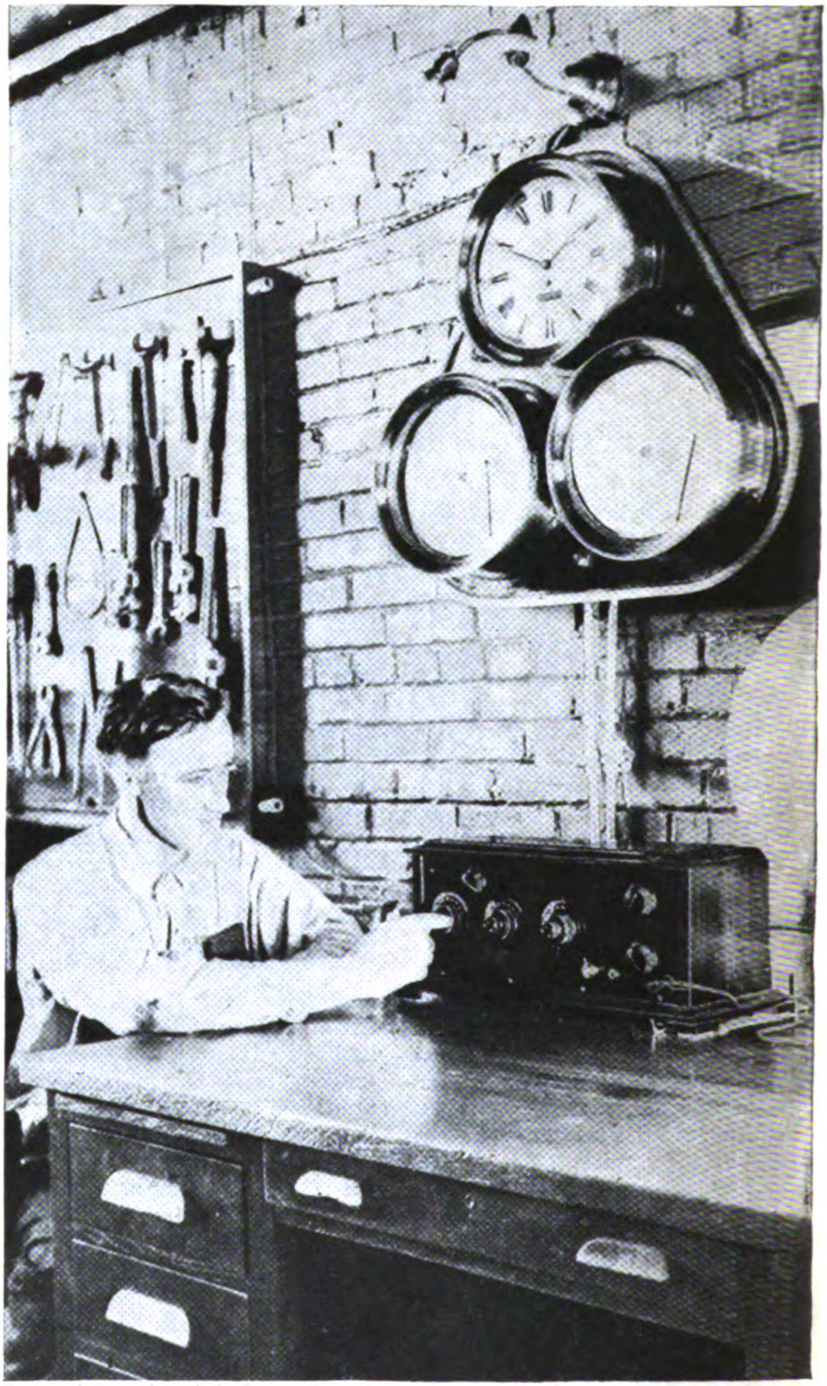
The official name of this trustworthy sentinel is 8-OIC. And its post of duty is located outside of the city of Akron, Ohio.

Before the installation of the automatic radio system the reservoir patrolman led a hard and irregular life. It was his duty to telephone the pumping station two or three times a day to report the water level in the basin. This method was partially satisfactory when telephone lines were in working condition, but it often happened that storms, ice or other agencies interfered with the communication system. As is usual with such emergencies, the breakdowns usually occurred during the most disagreeable weather; it also happened that the reservoir would be either too full or nearly empty at the same time. The patrolman would then be forced to crawl out of his warm bed in the wee, small hours of the night, hop into his car and drive nearly 20 miles through a blizzard to tell the pump operators how to regulate the water flow.

So the waterworks department set about to find a more reliable means of communication.

The plan to build an underground telephone line along the water main right-of-way was discarded when it was learned that the work would cost about $20,000. The installation of an electrical recording system would be equally expensive.

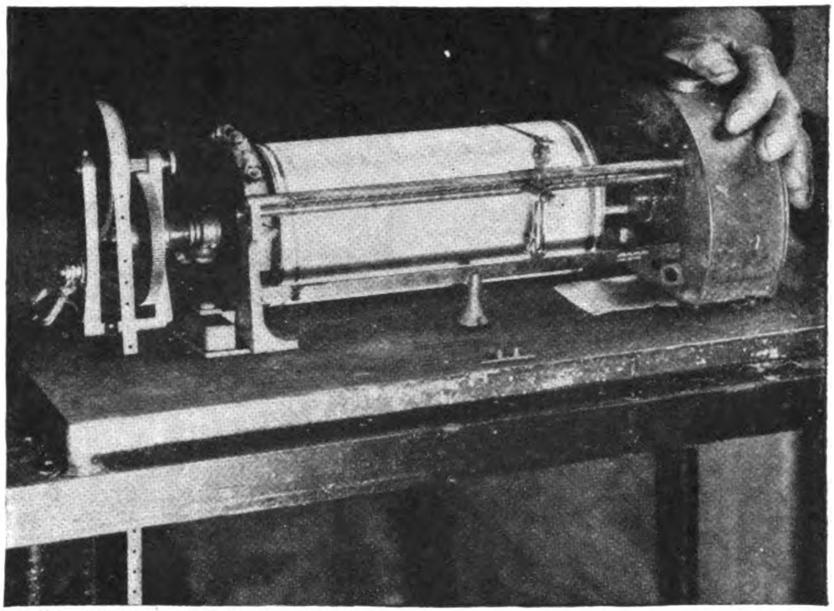
Then William A. Manfrass, an electrical engineer at the pumping station and an enthusiastic radio amateur, offered to solve the problem with a radio broadcasting and receiving system of his own design and construction.



From a photograph made for POPULAR RADIO

THE RECEIVING END OF THE "RADIO WATCHDOG" SYSTEM

In a corner of the pumping station is this short-wave set that receives the automatic signals from the water reservoir transmitter. A part of the loudspeaker that broadcasts the signals is shown at the right. Above the set is the meter panel with the clock that turns the receiver "on" at seven minutes to each hour. The contact point may be seen above the figure XI. William A. Manfrass, the designer of the system, is manipulating the dial.



From a photograph made for POPULAR RADIO

THE RECORDING APPARATUS AT THE RESERVOIR

This apparatus is above the vertical pipe in the reservoir valve house. The float indicating the water level is attached to the metal tape shown at the left. The tape passes over a wheel that turns a drum covered with graph paper, shown at the center, thus making a record of the water level variation. The tape also controls the contact arm of the circular switch at the right, thus making "live" one of the metal fingers shown in the illustration below.

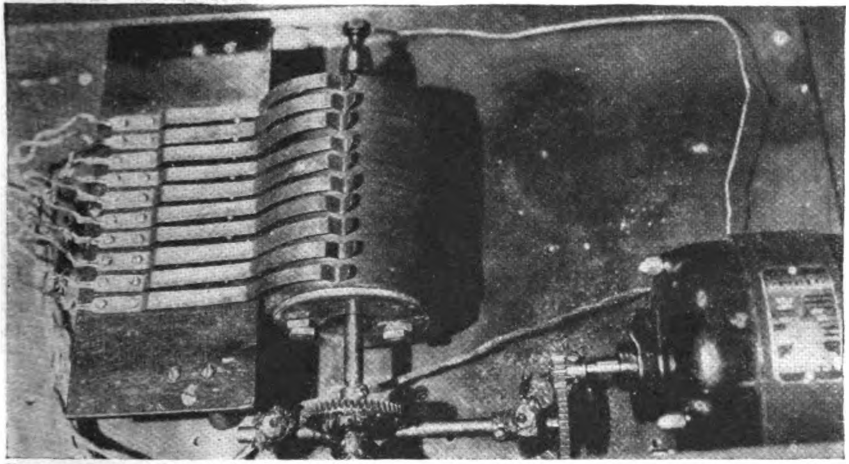
His offer was accepted, and the first trials in January, 1926, proved entirely satisfactory. The most noteworthy feature of the system, from the water-works officials' standpoint, was that the cost of all equipment was less than $500.

The sending set operates on 175 meters, is rated at 15 watts, and has a circuit of the coupled Hartley type. It is situated in the attic of the reservoir patrolman's home, several hundred feet from the automatic mechanism which operates it.

In the reservoir valve house is a float, operating in a vertical pipe; to this is connected a steel tape which passes over the wheel of a recording meter. On the end of this meter has been built a circular switch resembling a Ford timer. This is built up of alternate sections of brass and insulating material. A contact arm, rotating within the switch ring in accordance with the water level, determines which of the brass segments is "live."

A wire passes from each segment to a key-like device in another dust-proof case. There are ten keys in all, corresponding with an equal number of segments in the circular switch. The end of each key rests on a hard rubber disk, on the edge of which is a series of elevations and depressions arranged in the form of radio telegraphic signals. When the station is in operation, the entire set of disks revolves, but only the one operating the live key is functioning.

At five minutes to each hour, (except between eight and eleven o'clock each evening), a master clock turns on a relay, which switches the sending set "on." Another relay starts the 110-volt motor which operates the rubber disks. The station remains on the air for about 50 seconds, sending the combination of dots and dashes which reveals the water level. At the same time the water height is recorded on a meter chart for permanent record.



From a photograph made for POPULAR RADIO

THE METAL FINGERS THAT POINT OUT THE WATER LEVEL

At five minutes to each hour a relay starts the motor at the right; it rotates the ten hard-rubber discs in the center, each of which is engraved with metal code markings indicating a given water level. One of the metal fingers resting on the discs is made "live" by the contact arm of the circular switch in the illustration above. This completes the circuit to the transmitter and the message engraved on the disc under the "live" finger is sent through the ether to the receiver at the pumping station.

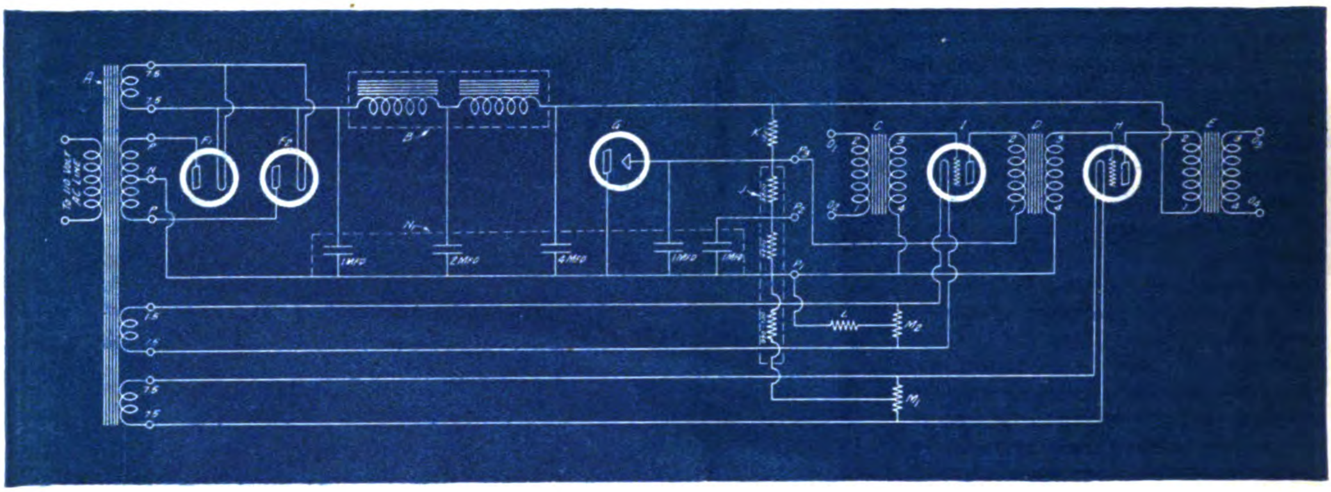
At seven and one-half minutes to each hour another clock at the pumping station turns "on" the receiving set, which remains in operation for five minutes. A red light lets attendants know when the set is "on." Signals are received on a short-wave, three-tube regenerative set, with two stages of low-frequency amplification. A loudspeaker makes it possible to hear the signals all over the station, above the noise made by the pumps. The building of an automatic recorder, operated by the signals, was believed impractical.

The information transmitted by the station is accurate to within one inch of water level. The closest reading is 1½ inch of the top, and the greatest is 9 feet 2 inches. The accuracy of readings increases as the water nears the top of the reservoir. When the maximum reading of 9 feet 2 inches is passed, the device repeats, the reservoir being about 30 feet deep. The repeating is not confusing, because it would require over four hours of pumping to raise the water level from 9 feet to the top of the reservoir.

During the operation of this radio sentinel the only expense for upkeep has been that resulting from the charging of batteries.

Considering the decreased cost of maintenance and the greater efficiency, it can be seen that radio is performing an invaluable service to the community in doing this work.

¶ *Quality amplification at low cost—High power with a few valves—Rapid construction with minimum labor—This summarizes the features of the Unipac.*



THE SCHEMATIC DIAGRAM OF THE POWER-PACK CIRCUIT

Figure 1: *At the extreme left is shown the full-wave rectifier with the filter circuit and the voltage-regulator valve in the center. Next to it, on the right, is the voltage-dividing resistor bank, and, at the extreme right, two stages of low-frequency amplification and the output transformer.*

REFRESHING QUALITY AND VIGOROUS AMPLIFICATION WITH

The LC-28 Unipac Amplifier

While affording an astounding volume, this new amplifier at the same time maintains a quality of tone that will caress the ears of the most discriminating listener. Although designed especially for the LC-28, the Unipac may be used in conjunction with receivers of practically any type.

By LAURENCE M. COCKADAY

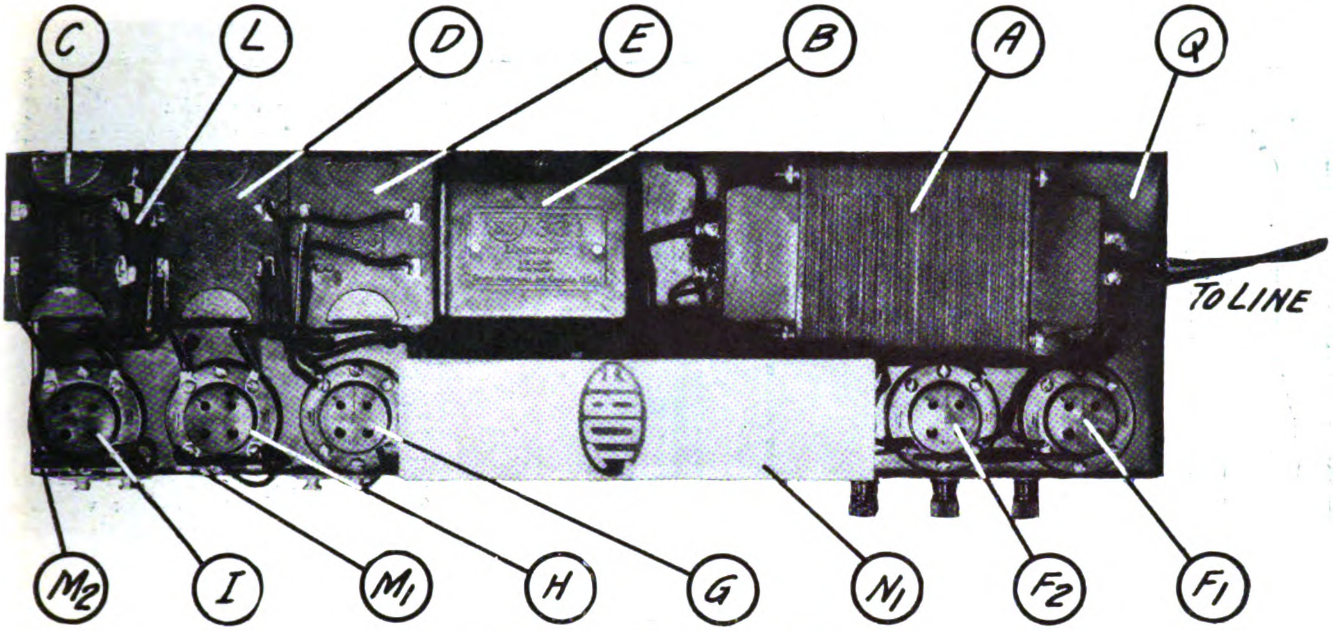
Cost of Parts—*Not over $82.00*

Here Are the Instruments and Accessories Necessary for Building This Unit—

A—S-M full-wave, super-power transformer, No. 328;
B—S-M Unichoke filter system, No. 331;
C and D—S-M special low-frequency transformers, No. 240;
E—S-M special output transformer, No. 241;
F1, F2, G, H and I—S-M valve sockets, No. 511;
J and K—Ward-Leonard resistor kit, No. S-651;
L—Frost resistor, No. F-1500;
M1 and M2—Frost resistor, No. FT-64;
N1—Tobe condenser bank, No. 662;
O1, O2, O3 and O4—Frost tip jacks, No. 253;
P1, P2 and P3—Eby binding posts (marked B—, 45, 90);
Q—Van Doorn steel chassis and cabinet, with hardware (nuts, screws, washers);
20 feet of Kellogg hook-up wire.

In previous articles in Popular Radio the story of the development of the LC-28 broadcast receiving set has been told. The specialization of the various functions of reception into separate units is a feature that makes possible the building of a set that is scientifically correct and that can be assembled to take care of the owner's exact needs.

In the October issue, complete details for constructing the high-frequency pack were given. This unit is used to pick up the broadcasting signals from the ether and to supply them to a low-frequency amplifier. The LC-28 Unipac is the first of a series of amplifiers designed for use with high-frequency packs to be described in Popular Radio, and it is designed especially for this purpose in connection with the LC-28 high-frequency pack. It may be placed in a console or radio table and connected and put



A TOP VIEW OF THE COMPLETE UNIT

FIGURE 2: *This shows the wiring arrangement of the transformers, sockets, chokes, condensers, and the power transformer which are mounted on the metal chassis, with the binding posts and the small jacks fastened on the lower side.*

into operation in a few minutes. The Unipac consists of two stages of low-frequency amplification with an output transformer, and it also contains a complete full-wave rectifier and filter as well as a supply for AC valve heaters. The outstanding features of the new Unipac are as follows:

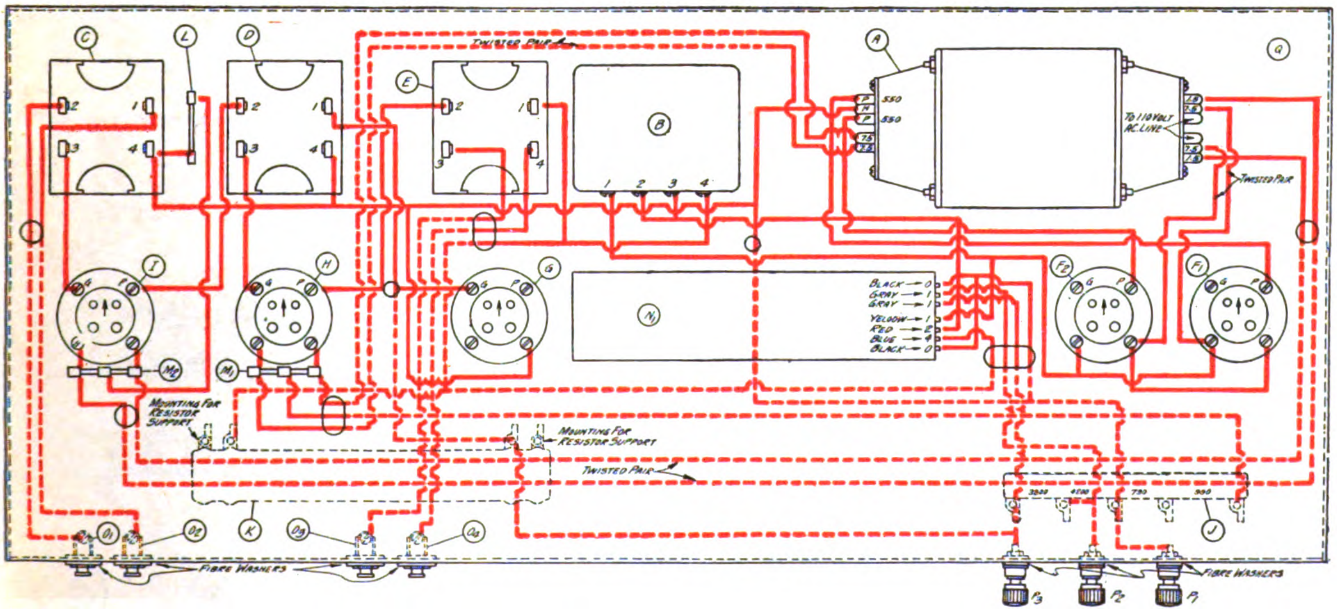
1. Complete AC operation without batteries;
2. It contains the new type low-frequency transformers designed especially for the LC-28;
3. It gives full-wave, high-power rectification;
4. It utilizes the new AC valve;
5. It gives excellent tone quality;
6. It is capable of great volume without overloading:
7. It supplies complete "B" voltages for the high-frequency pack.

The Unipac is mounted on a metal chassis with the same general type of construction followed throughout as is the case in the high-frequency pack. It contains a single condenser bank equipped with flexible leads for simplification in wiring and mounting. The unit is supplied with a cord and plug for attaching to the AC house-lighting lines.

The electrical circuit is shown schematically in Figure 1.

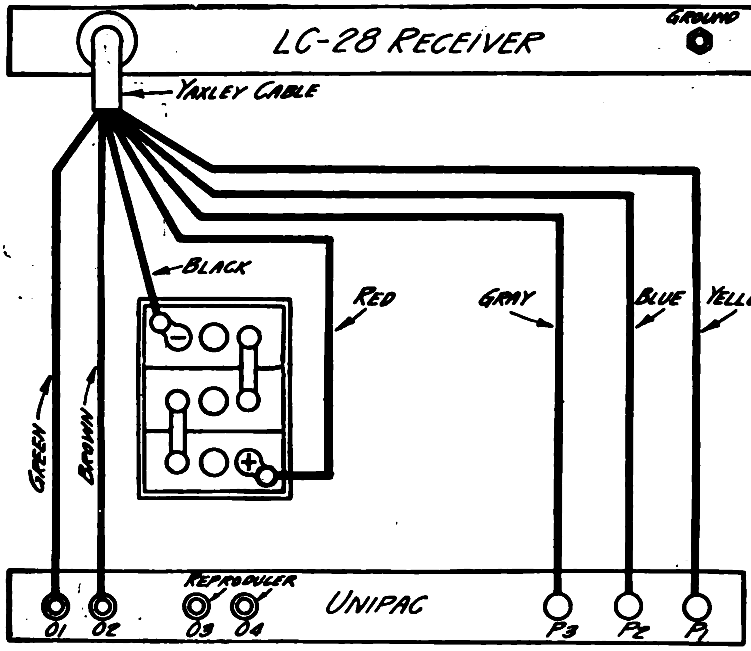
How to Construct the Unipac Amplifier

The metal chassis used for building up this unit may be obtained completely stamped and drilled, and the



THE PICTURE WIRING DIAGRAM OF THE UNIT

FIGURE 3: *In this drawing all the instruments mounted on the top of the metal chassis are shown in solid* BLACK *lines, while those parts that are mounted beneath are shown in dotted* BLACK *lines. All of the wiring is shown in* RED *lines. The solid lines indicate the wiring done on top of the chassis, while the dotted lines show the wiring done beneath.*



HOW TO CONNECT THE POWER-PACK TO THE LC-28

FIGURE 4: *This shows the connection between the LC-28 high-frequency pack and the Unipac. The connections should be made with the Yaxley cable that comes with the high-frequency pack. The colors of the connecting wires are indicated.*

parts should be mounted by means of screws and nuts in the positions shown in Figures 2 and 5.

There is no necessity for a complete description of the mounting, except that the precautions of position, as indicated in Figure 3, for the sockets and for the transformers should be carefully followed.

A bottom view of the Unipac is shown in Figure 5, and this gives a clear idea of the mounting of the two resistors, J and K, as well as the three binding posts and the four small jacks.

Be sure that all bolts for fastening down the instruments are tightened carefully; and the bolts on the large transformer, A, should be equipped with lock washers to prevent loosening.

This completes the constructional work, and the Unipac is now ready for wiring.

How to Wire the Unipac

The picture wiring diagram in Figure 3 shows the instruments in their correct positions and outlined in black lines. The units outlined in solid black lines are mounted at the top of the chassis, while those in dotted lines are mounted beneath the metal chassis. The same holds true of the wiring—the heavy red wiring runs above the chassis, while the dotted red wiring runs below. The connections are to be made with Kellogg flexible covered hook-up wire.

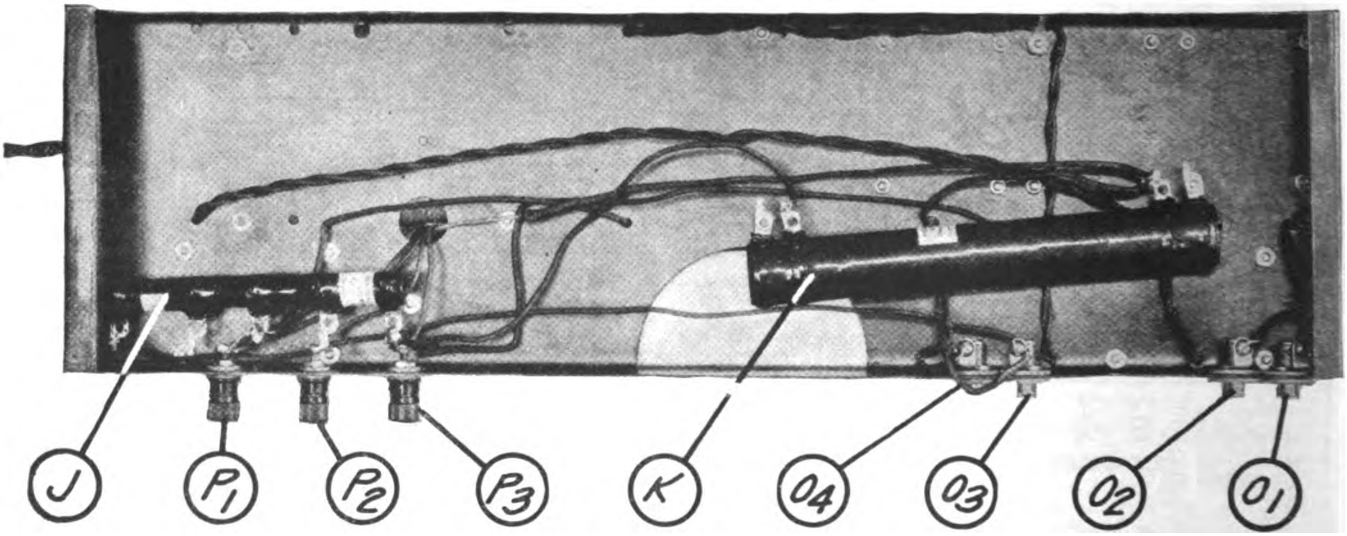
If the directions given in the diagrams are followed exactly, no trouble will be experienced in wiring, and the job will be a simple procedure.

How to Operate the Unipac

The new amplifier should be placed in the console or radio table underneath the LC-28 receiver and should be connected by means of the Yaxley

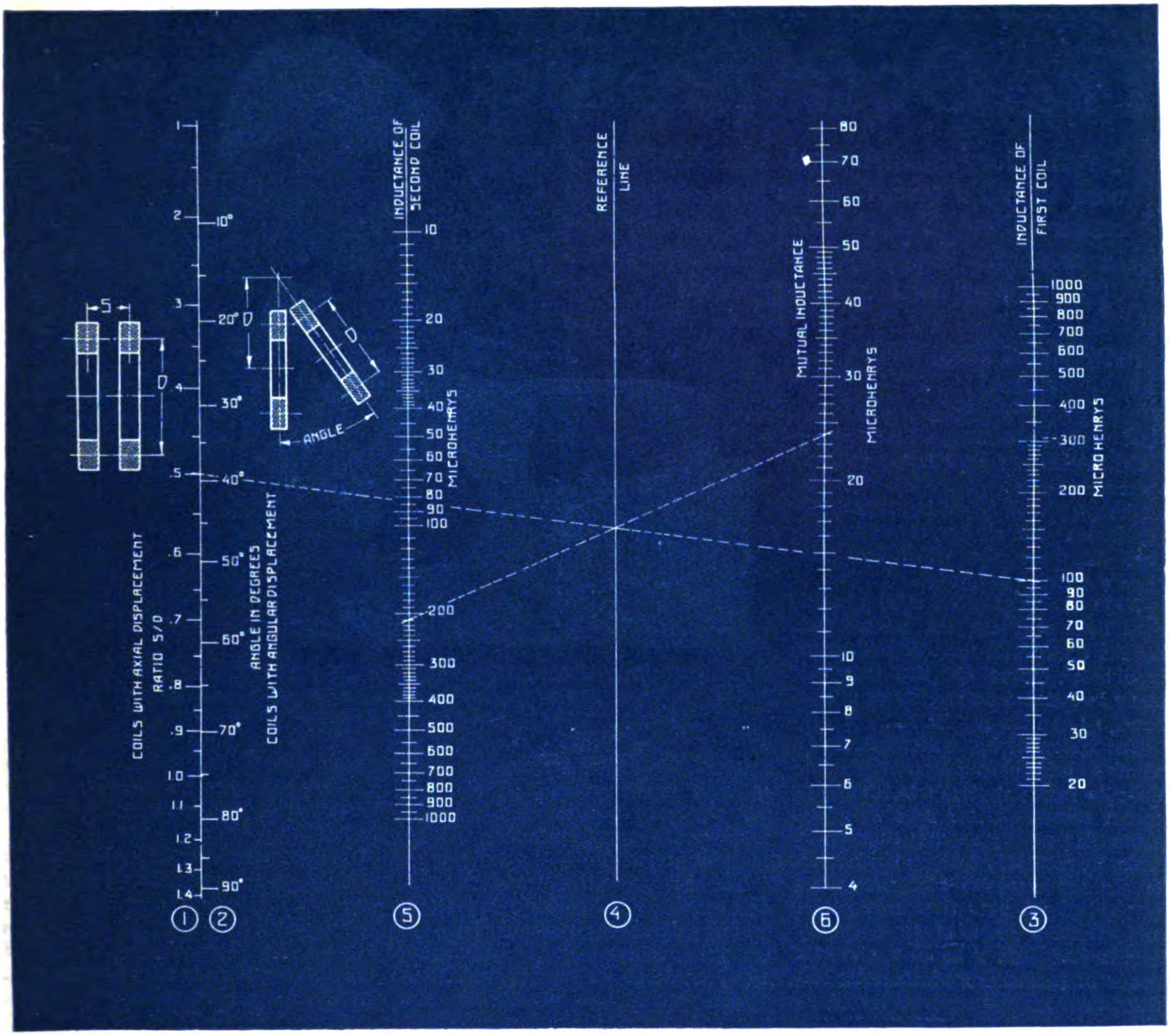
(*Continued on page 355*)

¶ *The list of parts given on page 324 includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* POPULAR RADIO *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* POPULAR RADIO SERVICE BUREAU, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



A VIEW OF THE UNIPAC FROM BENEATH

FIGURE 5: *This gives a clear idea of the mounting of the resistances, the binding posts and the small tip-jacks on the under side of the chassis. It also gives a good idea of the method of wiring.*



A MEASUREMENT CHART

For Use in Calculating the Mutual Inductance of Coils with Axial or Angular Displacement

By RAOUL J. HOFFMAN, A.M.E.

WHEN coupling two high-frequency circuits together, there is a choice of two general methods that may be employed:

1. Magnetic coupling;
2. Electrostatic coupling.

In some cases, a combination of these two methods is used; in most cases, however, either an inductive or direct magnetic coupling is employed.

When varying the coupling in two circuits, the mutual inductance also changes, and this value is often somewhat difficult for the radio experimenter to determine with accuracy.

In preparing this chart, the coupling of two coils of rectangular cross-section has been considered. The two circuits, acting upon each other, have a mutual inductance which follows the equation

$$M = K \sqrt{L_1 \times L_2}$$

wherein

M = the mutual inductance;
L1 = the inductance of one coil;
L2 = the inductance of the other coil;

and

K = the coupling factor of the coils with a given displacement.

If the two circuits are in resonance the original inductance values, L1 and L2, will be increased by the amount of the mutual inductance, M.

In the accompanying chart the coupling factor of the two coils has been plotted with axial displacement on scale No. 1 and with angular displacement on scale No. 2. The two drawings of the coils indicate just what is meant by "axial" and "angular" displacement.

The chart has been made up for coils that have the same diameter.

For example:

Let us calculate the mutual inductance for two coils with an average diameter

(*Continued on page 355*)

A Circuit That Is New in Principle and Performance—

The Octa-monic

To the four fundamental circuits already used in radio reception the Octa-monic Receiver adds a fifth—a circuit absolutely new in principle that employs "harmonic detection" with amazing results

By JOHN BRENNAN

DURING the past few years the "circuit mills" have been turning out their grist of new hook-ups without interruption. So intensive has been this production that it would be difficult for any fan or radio engineer to enumerate even those receivers which have become nationally prominent.

While the number of these circuits have been countless, the fundamental circuits upon which most of them have been based are so few that they can easily be counted on the fingers of one hand.

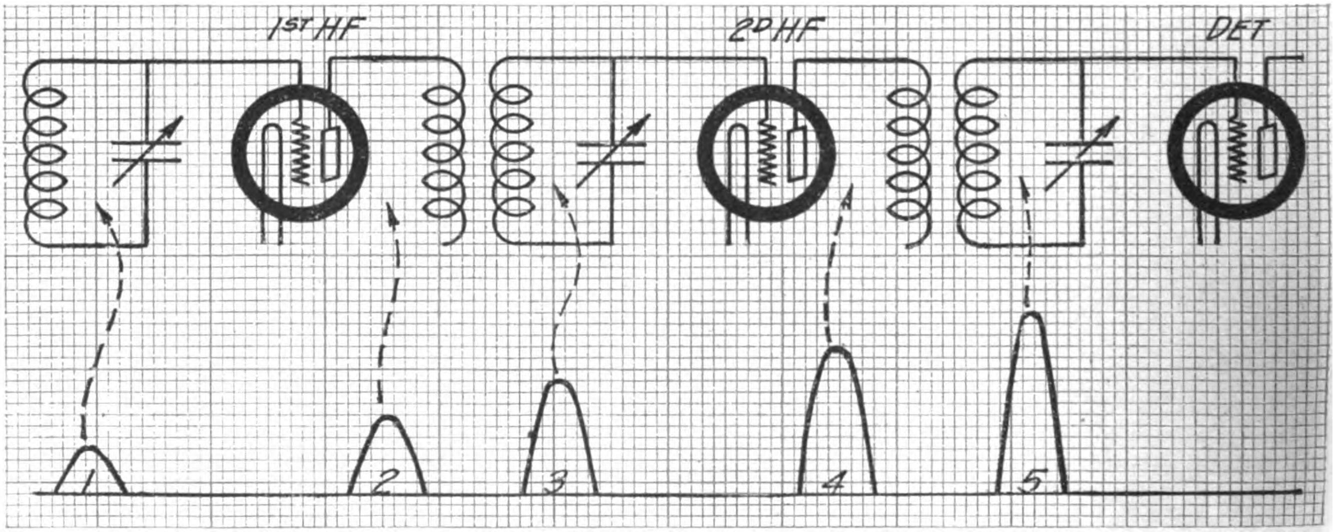
DAVID GRIMES CHECKS OVER THE OCTA-MONIC

Here is David Grimes, the designer of the Octa-monic circuit, making a final survey of the completed receiver.

The first really new and fundamental circuit to bring greater power and sensitivity to radio reception was the regenerative circuit. If one cares to investigate the regenerative circuit's claim to fame, he need only look up the records in distance reception that were hung up by simple one-valve regenerative sets with two stages of low-frequency amplification. In spite of the greater power of present-day broadcasting stations, there are few receivers to-day, no matter how many valves they may utilize, that can consistently reach out for the coast-to-coast reception obtained with the regenerative circuit during past years.

The old regenerative circuit, however, had one major and several minor faults which would render it obsolete for present-day requirements: Its poor selectivity would be an insurmountable objection to its use nowadays. The regenerative receiver did a good job in its day, under the then existing conditions, but progress has moved on apace and left it behind.

The next worth-while development in circuits was the tuned-high-frequency circuit. This circuit grew out of the untuned-high-frequency circuit which became popular when only a handful of broadcasting stations were in operation. As the number of stations increased,



HOW SELECTIVITY DEVELOPS IN THE ORDINARY RECEIVER

FIGURE 1: *The circuit is that of an ordinary three-valve, high-frequency amplifier, with the resonance curve of each circuit shown below. Note that while the amplitude increases steadily, the selectivity, as indicated by the width of the curve, is increased only by the two tuned transformers, at 3 and 5.*

untuned-high-frequency amplification passed out of general use, as its selectivity depended on a single tuned stage and was not adequate for modern conditions.

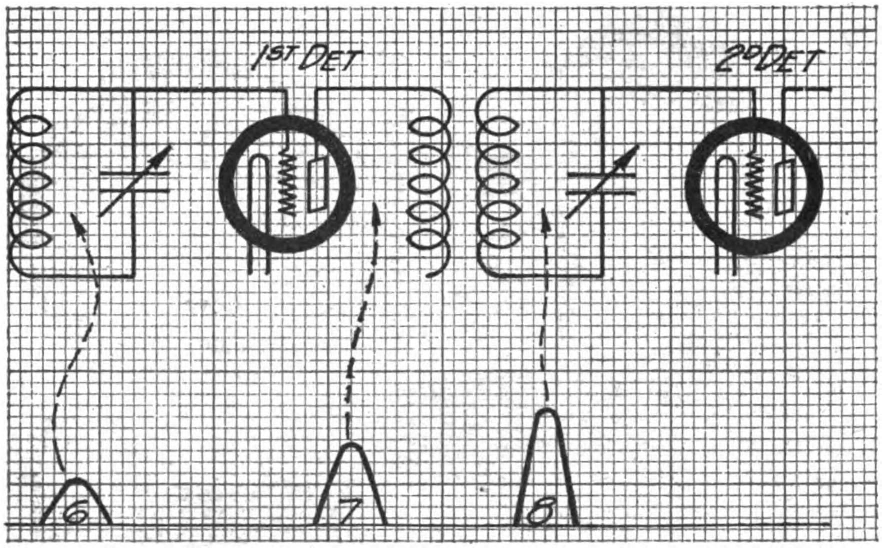
With various refinements, tuned-high-frequency has enjoyed a well-earned popularity. Tuned-high-frequency amplification has done much to permit radio fans to navigate the maze of radio broadcasting stations whose programs interfered with each other when the ordinary receiving circuits were employed.

As far as selectivity is concerned, it has always been acknowledged that the superheterodyne circuit, the third of the fundamental circuits, stands supreme. But the unusual selectivity of the superheterodyne may become one of its most flagrant faults, simply because this selectivity is often obtained at the expense of tone quality. This sacrifice of tone quality cannot always be entirely eliminated in the superheterodyne, because its great sensitivity and selectivity depend upon the principle of converting the incoming wave into another wave of a longer wavelength (lower frequency), which often limits the tone-quality-giving side-bands that can be amplified by this system.

Some of the other disadvantages of the superheterodyne are its high cost, the difficulty of obtaining suitably matched units, and its characteristic of bringing in a station on more than one point on the dials, making operation and logging of stations sometimes quite bothersome.

The reflex and inverse duplex systems, while based on tuned and untuned-high-frequency amplification, untilized the same valves twice for both high-frequency and low-frequency amplification.

The inverse duplex system, with the additional selectivity and sensitivity imparted by the famous Grimes development of automatic regeneration, was probably the outstanding development of the reflex circuit.



HOW THE OCTA-MONIC CIRCUIT DEVELOPS SELECTIVITY

FIGURE 2: *The two-valve Octa-monic circuit obtains the same increase in selectivity as that in Figure 1, with one less stage; one increase is introduced at 7 by the new principle of "harmonic detection" and another at 8 by the tuned transformer.*

Up to the present time, therefore, there have been four fundamental circuits. These four circuits are:

The regenerative circuit;
The tuned-high-frequency circuit;
The superheterodyne circuit;
The reflex circuit.

Now there has come upon the stage a circuit which uses a new idea in obtaining still greater selectivity without the usual line-up of intricate controls, variable couplings, delicately adjusted circuits and the various other devices that have usually been added to tuned-high-frequency circuits to increase selectivity.

It was while working on the refinements of various types of tuned-high-frequency and reflex circuits in developing the inverse duplex system of amplification that David Grimes discovered the alluring possibilities of selectivity which were inherent in the standard type of vacuum valve. Grimes noticed that when rectification took place in the high-frequency valve harmonics were generated, which caused the broadcast stations to appear not only at their proper dialing, but on their half wavelength (double the frequency) as well.

It was found that the signals were not as strong at the harmonic generated at double the frequency by the detector valve, but that the signals generated at these double frequencies were much sharper, by far, than the signals obtained at the fundamental carrier frequency.

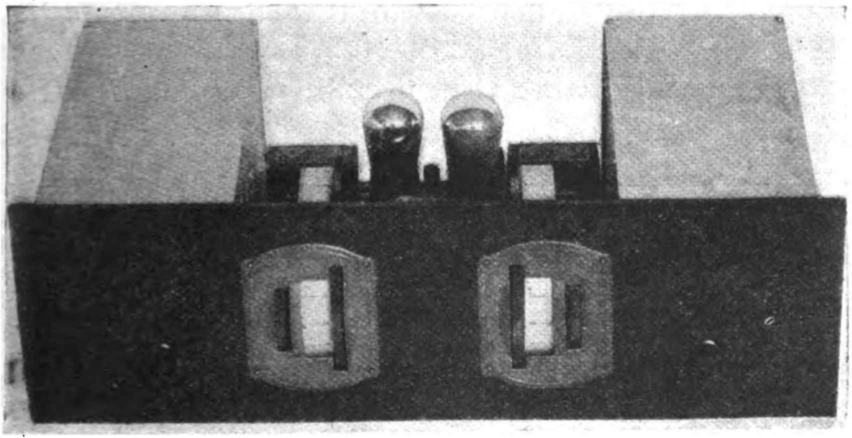
By careful tests and measurements, Grimes soon obtained sufficient data to prove mathematically that the generation of second harmonics increased the selectivity in proportion to the square of the incoming signal.

With the discovery of this remarkable action of the vacuum valve which results in a geometric increase in selectivity in the valve itself, a fifth fundamental circuit has been added to the list already enumerated.

The Octa-monic circuit, as this new circuit has been named, is distinctly different in its manner of performance from that of the other four fundamental circuits. It operates on the principle of wave-changing, but this wave-changing is accomplished automatically.

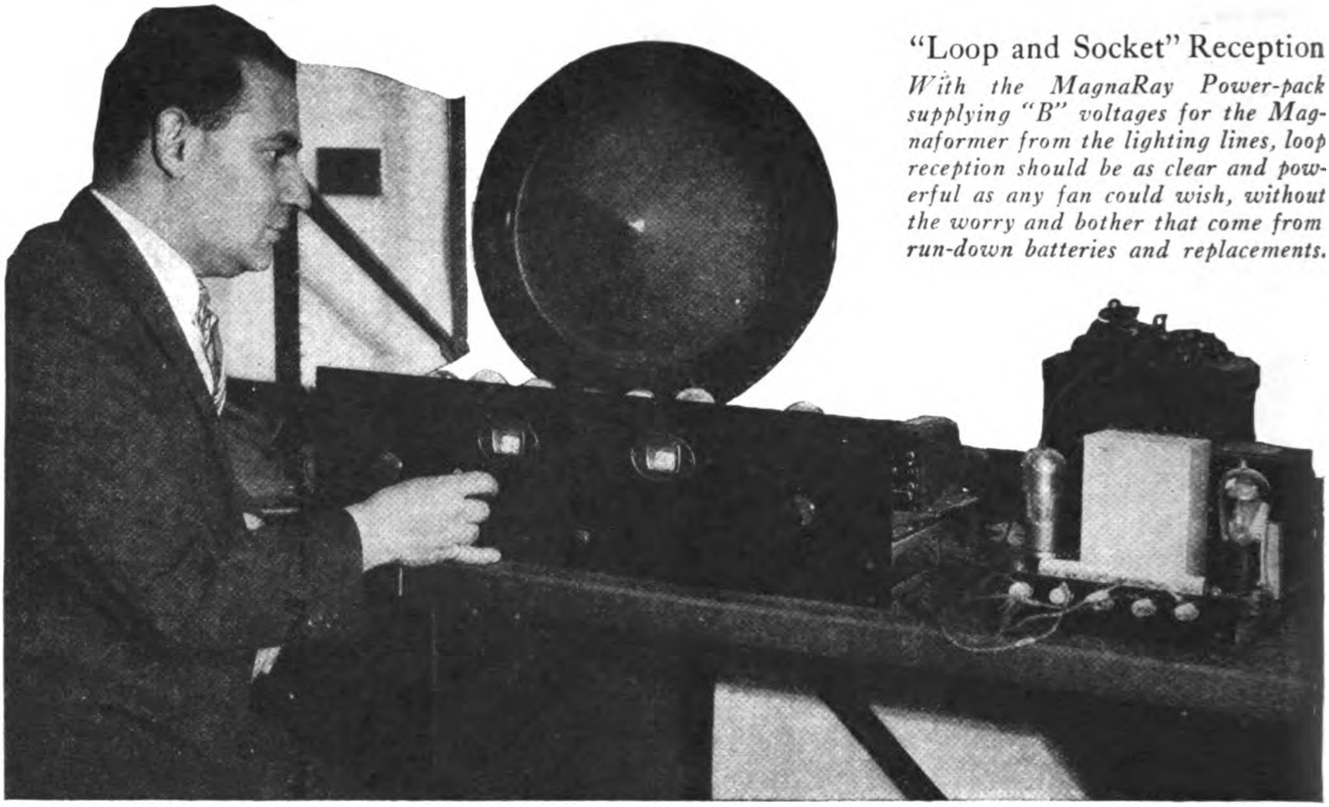
Every broadcast signal is brought into the receiver by means of the ordinary tuned circuit, but only the double-

(*Continued on page 354*)



A VIEW OF THE COMPLETE RECEIVER

There is an appearance of balance about the Octa-monic receiver, due to the placing of the drum dials and other panel controls, and the arrangement of the two shields behind the panel.



"Loop and Socket" Reception

With the MagnaRay Power-pack supplying "B" voltages for the Magnaformer from the lighting lines, loop reception should be as clear and powerful as any fan could wish, without the worry and bother that come from run-down batteries and replacements.

SNAPPY "B" POWER FOR THE MAGNAFORMER WITH

The MagnaRay Power-Pack

Superheterodyne reception may be brought to a new plane of quality and efficiency with this "B" power-pack, designed especially for the Magnaformer 9-8 Receiver. Here are the complete constructional details for this unit, that will develop, at 200 volts, 85 milliamperes of steady "B" current.

By LAURENCE M. COCKADAY

COST OF PARTS—*Not over $45.00*

HERE IS A LIST OF PARTS NECESSARY FOR BUILDING THIS UNIT—

A—National power transformer;
B—National filter-choke coils, type 80;
C—Tobe Special "B" block, type 760-G (2, 2, 6, 1, 1 and 1 mfds.);
D and E—Benjamin Cle-ra-tone vibrationless sockets;
F—Lynch wire-wound resistor, type P, 4,000 ohms;
G—Tobe buffer condenser (.1 and .1 mfd., with a common terminal);
H—Lynch tapped output potentiometer resistor, type PRE;
I—Binding post strip, 1½ by 9¼ by 3/16 inch;
J1, J2, J3, J4 and J5—XL aluminum binding posts;
K—Wooden baseboard, 9¼ by 10 by ⅜ inches.

IN VIEW of the popularity and the increasing number of requests from POPULAR RADIO readers for information concerning the proper power apparatus to be used with the Magnaformer loop receiver, a new power-pack has been developed especially for use with this instrument. It is the work of a number of engineers of various companies specializing in this work.

The new unit that has been officially adopted as the standard for this receiver is called the MagnaRay Power-Pack. It incorporates a number of interesting features that make it especially suitable for this work.

It is built of sectionalized units comprising a power transformer, a filter-choke unit and a condenser bank, which are enclosed in cans to cut stray fields to a minimum. It uses a filamentless rectifier valve of the Raytheon BH type, capable of delivering 85 milliamperes at 200 volts.

Another feature is the utilization of the new Raytheon voltage regulator "R" type valve that keeps all voltages applied to the set constant at all times in spite of voltage fluctuations in the house-lighting power. The use of this valve also precludes any possibility of "motor boating."

The cost of this unit is not more than that of the usual high-grade "B" power-pack *without* a voltage regulator.

The unit may be used with any other receiver needing a constant source of "B" voltages from 22½ volts to 200 volts, using the lighing lines.

How to Construct the Unit

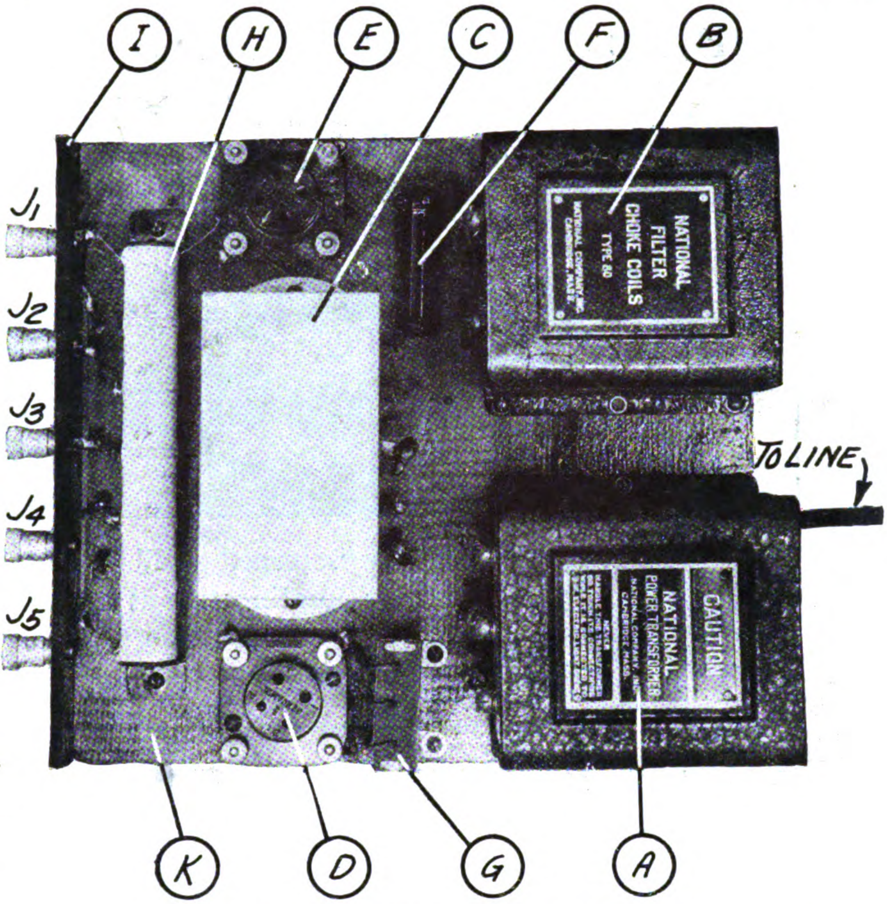
The new unit, as may be seen from Figure 1, is mounted on a wooden baseboard, K. A suitable piece of well-dried wood should be used for this purpose, with two one-inch strips fastened across the ends to raise it from the surface on which it is to stand. This will allow running the wires underneath. This wooden baseboard should be cut to a size of 9¼ by 10 by ⅜ inch.

After this has been prepared, the next job is to mount the binding posts J1, J2, J3, J4 and J5, on the binding-post strip, I. The strip may then be mounted on the edge of the baseboard with flat-head wood screws.

Next, mount the transformer, A, by means of four wood screws in the position shown in Figure 1. The filter-choke unit, B, may be mounted on the opposite corner of the baseboard as shown in the same illustration.

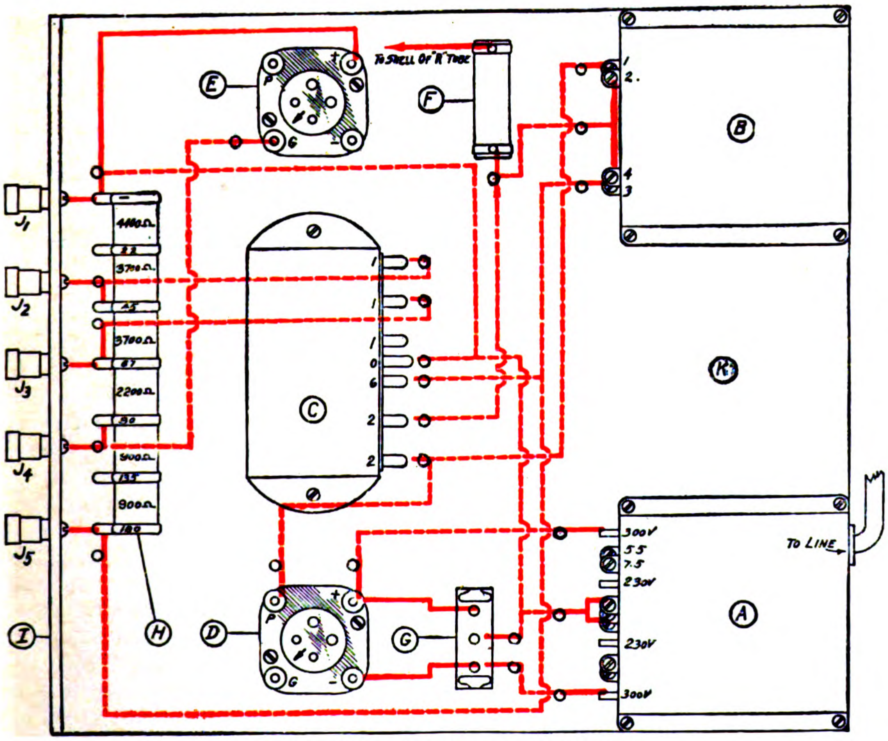
Next, mount the condenser block, C, by means of two round-head wood screws as shown in the same illustration. The resistance unit, F, is supported by the connecting wires and need not be mounted until later. Fasten down the buffer condenser, G, with two screws as indicated.

Now fasten down the two sockets, D and E, with two screws to each socket. The last mounting job will be to fasten down the resistance unit, H, by means of two screws, one at each end of the resistor.


I
H
E
C
F
B
J1
J2
J3
J4
J5
NATIONAL FILTER CHOKE COILS TYPE 60
TO LINE
CAUTION
NATIONAL POWER TRANSFORMER
K
D
G
A

THE PANEL LAYOUT OF THE MAGNARAY

FIGURE 1: *The mounting of the instruments on the wooden baseboard is a simple matter, as this picture shows. Most of the wiring is done under the baseboard.*



THE PICTURE WIRING DIAGRAM

FIGURE 2: *The dotted* RED *lines show the wires to be run under the baseboard, and the solid* RED *lines the wires above the baseboard. The instruments are outlined in* BLACK.

Be sure all of the units are fastened in the positions indicated in Figure 1.

This completes the construction work on the power-pack and it is ready to be wired. Refer constantly to the picture wiring diagram in Figure 2 in making connections. This diagram shows the instruments laid out in approximate positions, and the wiring is shown in heavy colored lines. Those wires that run above the wooden baseboard, K, are shown in solid lines, while the wiring running beneath the baseboard is shown in dotted lines. The wiring should be done with rubber-covered hook-up wire.

The diagrams are so complete and so easy to follow that no specific written instruction for wiring is necessary.

One wire that holds the resistor, F, runs through the baseboard, and one wire should be soldered and fastened by a clip to the metal shell of the regulator valve in socket E.

When the wiring has been completed the unit is ready for installation.

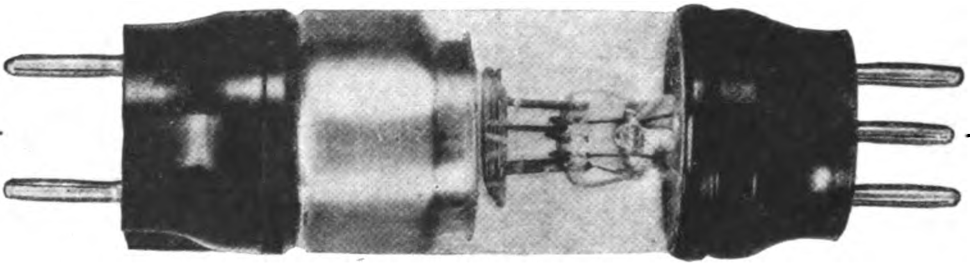
How to Hook Up the MagnaRay With the Magnaformer Receiver

The unit may be placed in the bottom portion of the console or radio cabinet upon which the Magnaformer receiver

(*Continued on page* 360)

Eliminate "Squeals" With the New High-Mu 2-Grid Valve

By L. JAMES

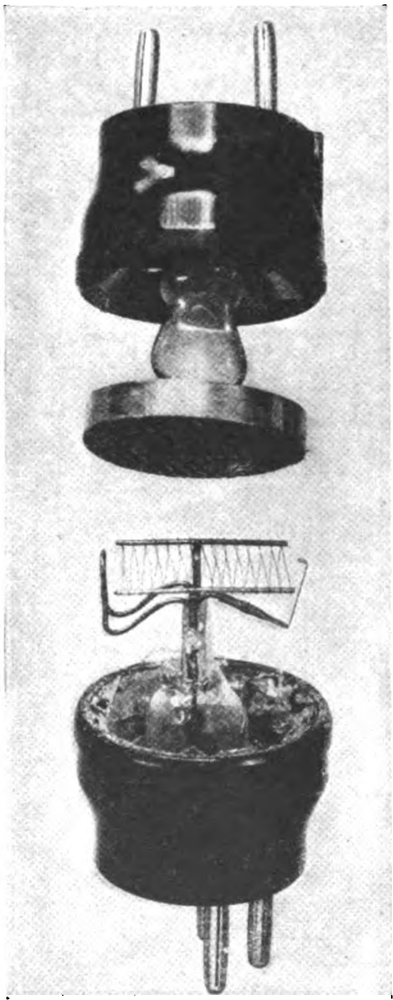


With this remarkable new "screened grid" valve a single high-frequency stage can be made to give amplification as high and as stable as an ordinary three-stage amplifier—and this can be done without any of the intricate methods formerly used to prevent feedback and "howling."

A NEW valve recently perfected by the British Marconi Company possesses many new and startling features that should be of absorbing interest to radio enthusiasts.

This valve is almost certain to have the effect of modifying the design of the high-frequency part of receivers, and, in fact, receivers have been prepared which utilize this new instrument. The valve has four electrodes—a filament, control grid, screen grid and plate. It should not be confused with the ordinary four-electrode valve. The new valve has distinctive features, being so designed that the capacity between the control grid and the plate is negligible when the screen is connected to a point at earth potential, such as one side of the filament battery, or to the plate battery. Also, the plate impedance and voltage factor of the new valve are of quite a different order of magnitude from those usual in the ordinary types of receiving valves.

The construction of the new valve is clearly shown in Figures 1 and 4. It will be seen to comprise a normal filament and grid; the filament is of the thoriated type, rated at 5 volts, .25 ampere, while the grid has the shape shown in the illustration. These elements are mounted at one end of the valve, a cap with three pins being provided. At the opposite end is mounted the screen and plate. The screen is of wire gauze having a fairly fine mesh welded to the edge of a circular metal band. Quite close to the gauze is a circular metal plate with dished edges which is used as the plate. These elements are mounted at the opposite end of the valve from the grid and filament, and two pins are provided for connections.



ELEMENTS OF THE NEW VALVE
FIGURE 1: *The plate and "screen" grid are in the top section, and the filament and "control" grid in the lower.*

Before one can fully appreciate the factors which led to the development of the new valve, one must consider in what way the original three electrode valve has proved to be defective.

An ordinary three electrode receiving valve has capacity between its grid and plate. This provides a coupling between the plate and grid circuit with the result that the amplified voltages in the plate circuit cause current to flow back to the grid circuit. It so happens that this current is usually of such magnitude and phase as to cause the stage to oscillate. Hence the most careful shielding of the components of these circuits is useless unless some means are provided for limiting the amount of current fed back through the valve's capacity, and various methods have been devised for neutralizing this capacity or for stabilizing the circuit.

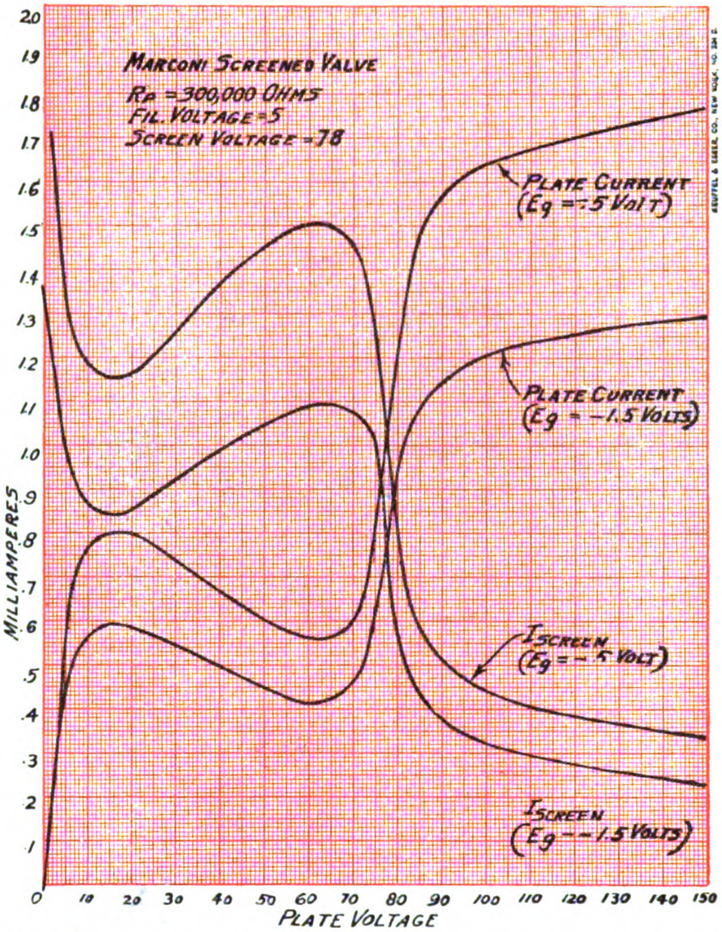
Methods for neutralizing the valve's capacity are, on the whole, satisfactory, but owing to imperfect neutralization, caused, in some instances, by the difference between the phase angle of the neutralizing condenser and that of the valve's capacity, and in other instances by failure to provide a sufficiently tight magnetic coupling between the coils associated with the circuit, the balance obtained is not perfect. This results in a varying amount of feedback at the various wavelengths to which the circuit may be tuned, with the result that in practice, the precaution has often to be taken of limiting the amount of amplification per stage.

Ordinary stabilizing devices usually act to limit the amount of amplification per stage, for this reduces the voltage difference of plate and grid, and therefore the amount of energy fed back from the plate to the grid circuit. Thus the tendency of the receiver to be unstable is reduced, but at the expense of amplification, and very often of selectivity as well.

As the main difficulty with high-frequency amplification is due to the valve's electrode capacity, it seems strange that only of late has a serious attempt been made to construct valves having a negligible plate to grid capacity, for with a valve of this type there would be no need to employ any of the special balancing or stabilizing devices so necessary with ordinary receiving valves. It would of course be necessary to remove completely all stray couplings between the individual stages of the receiver. This involves the removal of stray magnetic couplings due to the position of the various coils associated with the circuit, the removal of capacitative couplings due to the proximity of tuning coils, condensers, wires and other incidental apparatus, and of conductive couplings due to the impedance of connecting wires, batteries and so on.

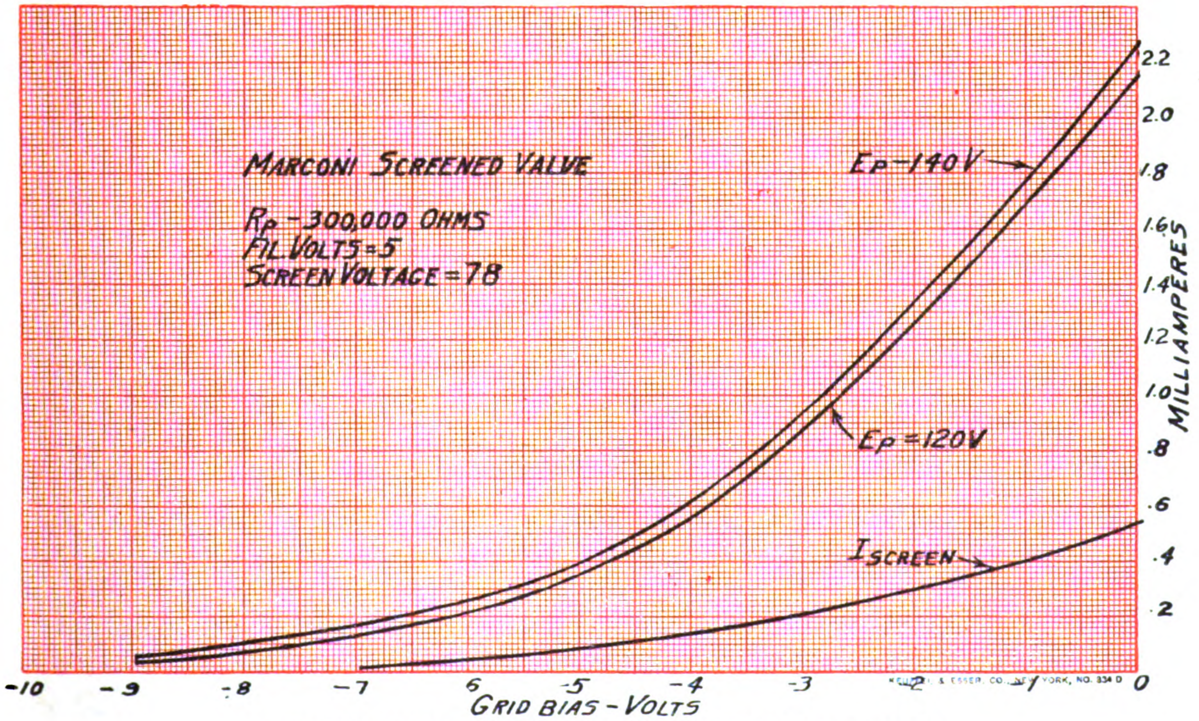
Thus it is necessary to use metal screens or metal boxes, by-pass con-

(*Continued on page 350*)



CHARACTERISTIC CURVES FOR THE SCREENED-GRID VALVE

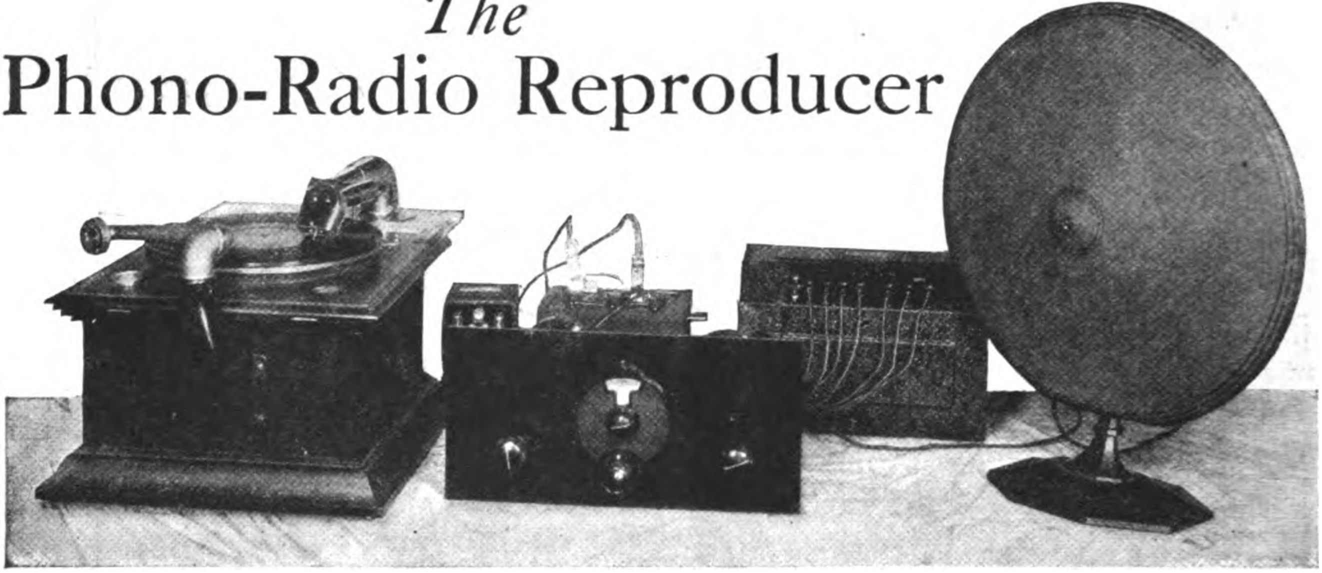
FIGURE 2: *In two of these curves the plate current is plotted against plate voltage. The other two curves show how the "screen grid" current varies under the same conditions.*



CURVES OF PLATE CURRENT AGAINST GRID VOLTAGE

FIGURE 3: *The two top curves indicate the variations of plate current with grid bias at two different plate voltages in the operating range. The lower curve shows how the screen current increases under these conditions.*

An Up-to-the-Minute High-Frequency Pack for Use With The Phono-Radio Reproducer



Here are the complete constructional details for an inexpensive yet highly efficient two-valve, high-frequency amplifier and detector, designed particularly for use in conjunction with the new electrical pick-up units and low-frequency amplifier packs that were described in POPULAR RADIO in the series of articles on combining the phonograph and the radio. The complete ensemble, such as is pictured above, should give broadcast and recorded reproduction of such variety and outstanding quality as to satisfy even the most exacting taste in aural home entertainment.

By JAMES MILLEN

COST OF PARTS—*Not over $42.00*

HERE IS A LIST OF PARTS FOR BUILDING THIS UNIT—

A and K—General Radio UX sockets;
B—9 by 13-inch bakelite sub-panel;
C1—Sangamo mica condenser, .00025 mfd.;
C2—Tobe condenser, 1 mfd.;
C3—Precise midget condenser, 50-150 mmfd., No. 940;
C4—General Radio neutralizing condenser;
C5—Sangamo mica condenser, .001 mfd.;
RFC—Samson RF choke, No. 85;
R1—Carter 20-ohm switch-rheostat, type M-20-S;
R2—Lynch equalizer and mounting, No. 2;
R3—Lynch metallized filament resistor, 2 meg., and mounting;
R4—Lynch 1,000-ohm suppressor and mounting;
T1 and T2—National Uni-Control B-D tuning unit complete with illuminated dial;
P—7 by 14-inch bakelite panel;
7 Eby binding posts.

A NEW trend in radio receiver design that is receiving considerable attention at present is the separation of the low-frequency amplifier from the receiver proper, as in the new LC-28.

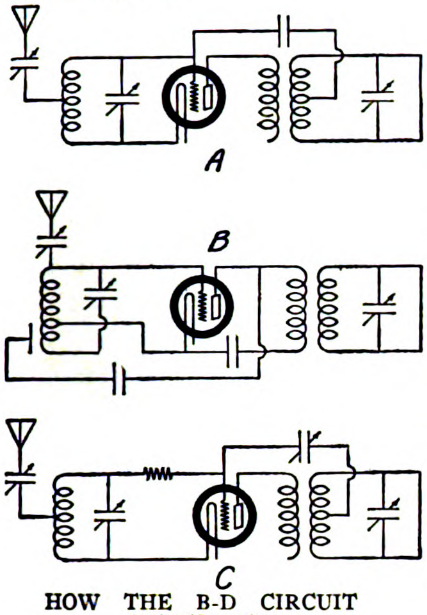
As a result, the complete receiver may be considered as two separate components — the high-frequency amplifier and detector, and the combination low-frequency amplifier and power-pack. The phonograph pick-up, of course, may be substituted at will for the high-frequency amplifier and detector, so that either radio programs or phonograph records may be reproduced at the turn of a switch.

In the preceding issue of POPULAR RADIO, the writer described a combination low-frequency amplifier and power-pack designed for just such use. This article gives the constructional details for a high-frequency broadcast pick-up for use with this amplifier.

In selecting the circuit for the receiver, simplicity of construction, general availability of the essential parts, stability of operation, ease of control, and high sensitivity (for the number of valves employed) were given careful consideration. It was finally decided to employ the new Uni-Control National B-D tuning unit, in a circuit of a revised type of design.

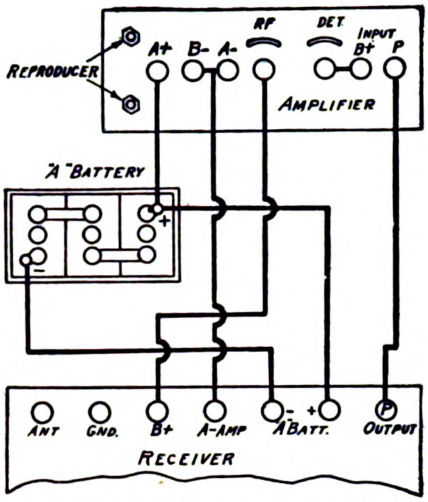
This new tuning unit consists of a standard B-D antenna inductance and high-frequency transformer mounted on a two-gang condenser of unique design. Instead of directly connecting the shafts of the two condensers together as a single unit, they are joined through a system of friction-driven planetary gears of the type used in the well-known National vernier dials which were so popular a few years ago. The shaft of the first condenser is hollow and through its center passes another shaft which is connected to a small knob located at the center of the main tuning dial. When the main dial is turned, both condensers rotate. When the small knob is rotated, a vernier adjustment of the antenna tuning capacity may be made without changing the setting of the other condenser.

In the past it has always been necessary either to use a separate condenser for tuning the antenna circuit, or else, if the antenna condenser were ganged to another condenser, to employ a separate "trimming" condenser. With the new arrangement, however, these difficulties are overcome and at



HOW THE B-D CIRCUIT DEVELOPED

Figure 1: *At the top is the simplified schematic circuit of the original Browning-Drake circuit. At B is a modification of this circuit which has become known as the "Official" Browning-Drake circuit. At C is a further modification used in the unit described in this article.*



THE BATTERY HOOK-UP

Figure 2: *This diagram shows the proper connections to be made for operating the high-frequency pack with the power-pack amplifier described in the October number of* Popular Radio.

the same time vernier reduction mechanisms are furnished to facilitate the adjustment of either the main or auxiliary knobs. As a rule, the small auxiliary knob need only be used when tuning for distant stations.

In many of the earlier receivers constructed and described in the various radio magazines, a circuit comprising one stage of high-frequency amplification of the type developed by Prof. Hazeltine was employed in connection with a regenerative detector. This circuit is shown at A in Figure 1.

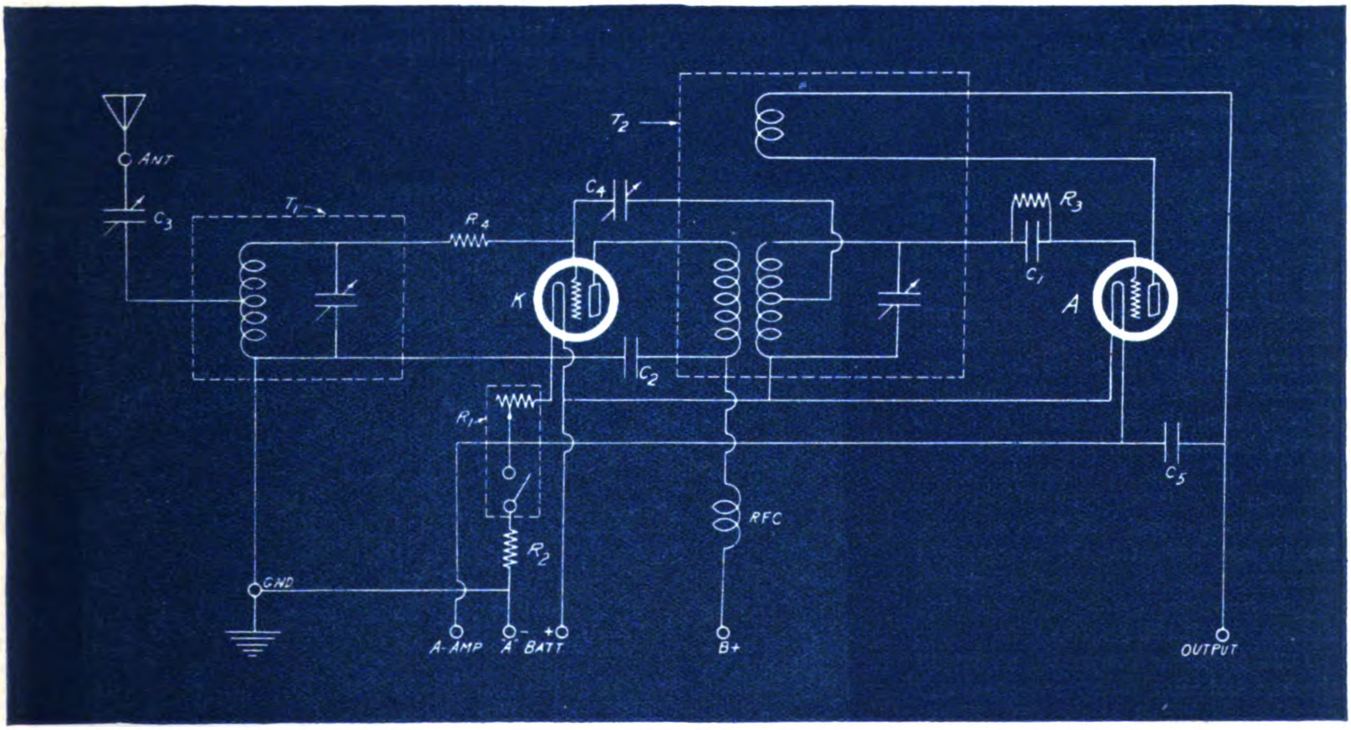
With this circuit arrangement, however, it was usually necessary to employ one of the small UX-199 valves as a high-frequency amplifier rather than the more reliable UX-201-a. When the larger valve was used, it was found almost impossible to neutralize the receiver.

At B in Figure 1 is another circuit which was used by Browning and described by him in an article in the April, 1927, issue of Popular Radio. This circuit, when used with the B-D tuning units, has become known as the "Official" Browning-Drake circuit. A small valve was also found necessary for proper operation.

Recent experiment, however, has shown that if a suitable resistance be

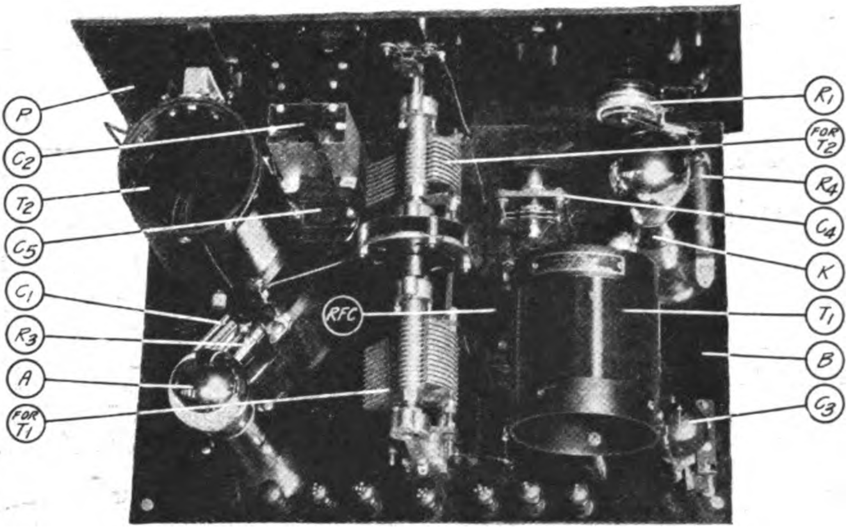
---

¶ *The list of parts given in this article includes the exact instruments used in the apparatus from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by* Popular Radio *and which may be used with good results. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* Popular Radio Service Bureau, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE SCHEMATIC WIRING DIAGRAM OF THE UNIT

Figure 3: *The lettering in this diagram corresponds to the list of parts and the constructional data in the text. As the wiring of the unit is quite simple, there should be no difficulty in doing it from this diagram.*



THE SUB-PANEL VIEWED FROM ABOVE

FIGURE 4: *This view shows clearly the mounting positions of the B-D tuning unit with its gang condenser, the two valve sockets and the other instruments.*

placed in the grid circuit of the first valve of the B-D circuit, as shown in Figure 1 at C, then no trouble will be had in neutralization when a UX-201-a type of valve is employed in place of the UX-199 type. As a result, the overall performance and reliability of the receiver is materially improved. In fact, it is possible, when employing such a grid resistor, to go even a step further and employ one of the new 5-volt, high-mu, high-frequency amplifier valves, such as the CeCo type K.

As the grid resistor is not located in the tuned circuit, it has no detrimental effects upon the selectivity of the receiver.

How to Construct the Receiver

As will be seen from Figures 4 and 5, the actual construction of the receiver is quite simple. Figures 7 and 6 give the layouts for the front panel and the sub-panel. Upon careful examination of Figures 4 and 5, it will be noticed that the resistor clips and socket contacts used by the writer in the construction of his receiver, were fastened directly onto the sub-panel. It is believed, however, that the average constructor will find it easier to obtain the standard resistor mountings and sockets, as specified in the list of parts, and to mount them in the conventional manner. The dimensions given in Figure 6 are for the Lynch mountings and General Radio sockets.

After preparing the panels, mount all the essential parts on the sub-panel and complete all wiring, as shown in Figure 3, except those connections to the dial light and switch-rheostat, R1, before mounting the front panel. If most of the wiring is run under the sub-panel the appearance of the completed receiver will be considerably enhanced.

Upon referring to the circuit diagram, in Figure 3, it will be noticed that there are two "A" negative (—) terminals. The extra one is added so that the switch on the panel of the receiver may also be used to control the filaments of the valves in the externally connected low-frequency amplifier. The rheostat is so located in the circuit as to control only the high-frequency amplifier valve and thus serve as a volume control.

The equalizor, or automatic filament-control resistor, R2, takes care of the detector valve and also prevents more than the rated 5 volts being applied to the high-frequency valve, even when the rheostat is set for minimum resistance.

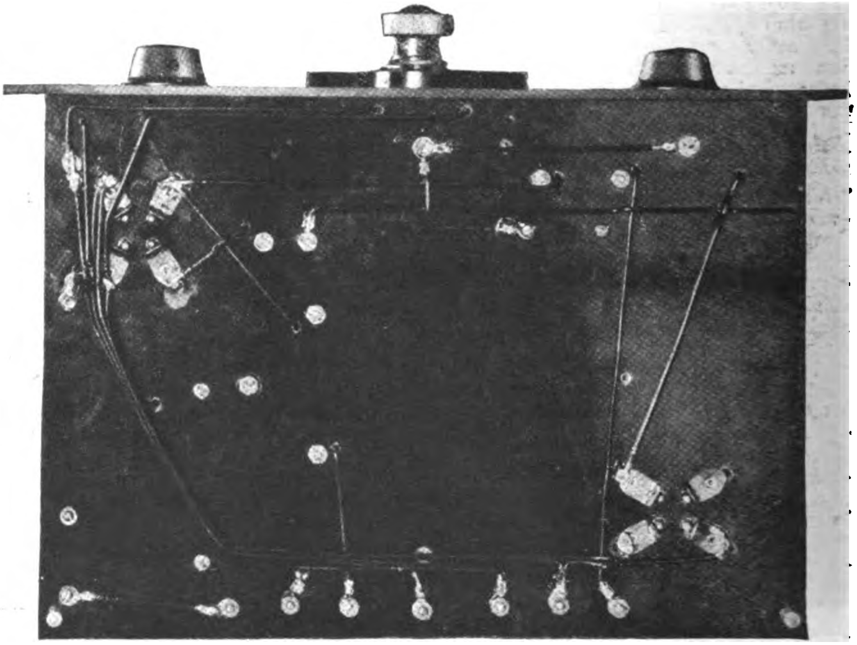
When completed, the receiver may either be placed in a small 14-inch cabinet, and the low-frequency amplifier and power-pack located in some out of the way place, or else the entire outfit may be installed in a console type of cabinet.

How to Install the Receiver

It is most important that the antenna used with this receiver be not over about fifty feet in length. In fact, most excellent results are generally obtained with but a short length of wire run around the room in which the set is located. Should such an indoor antenna be employed, however, care must be used to see that it does not run close to any lamp cords or other AC lines not covered with a grounded shield such as the standard BX Cable. If such precaution is not taken a slight AC hum may be heard in the reproducer.

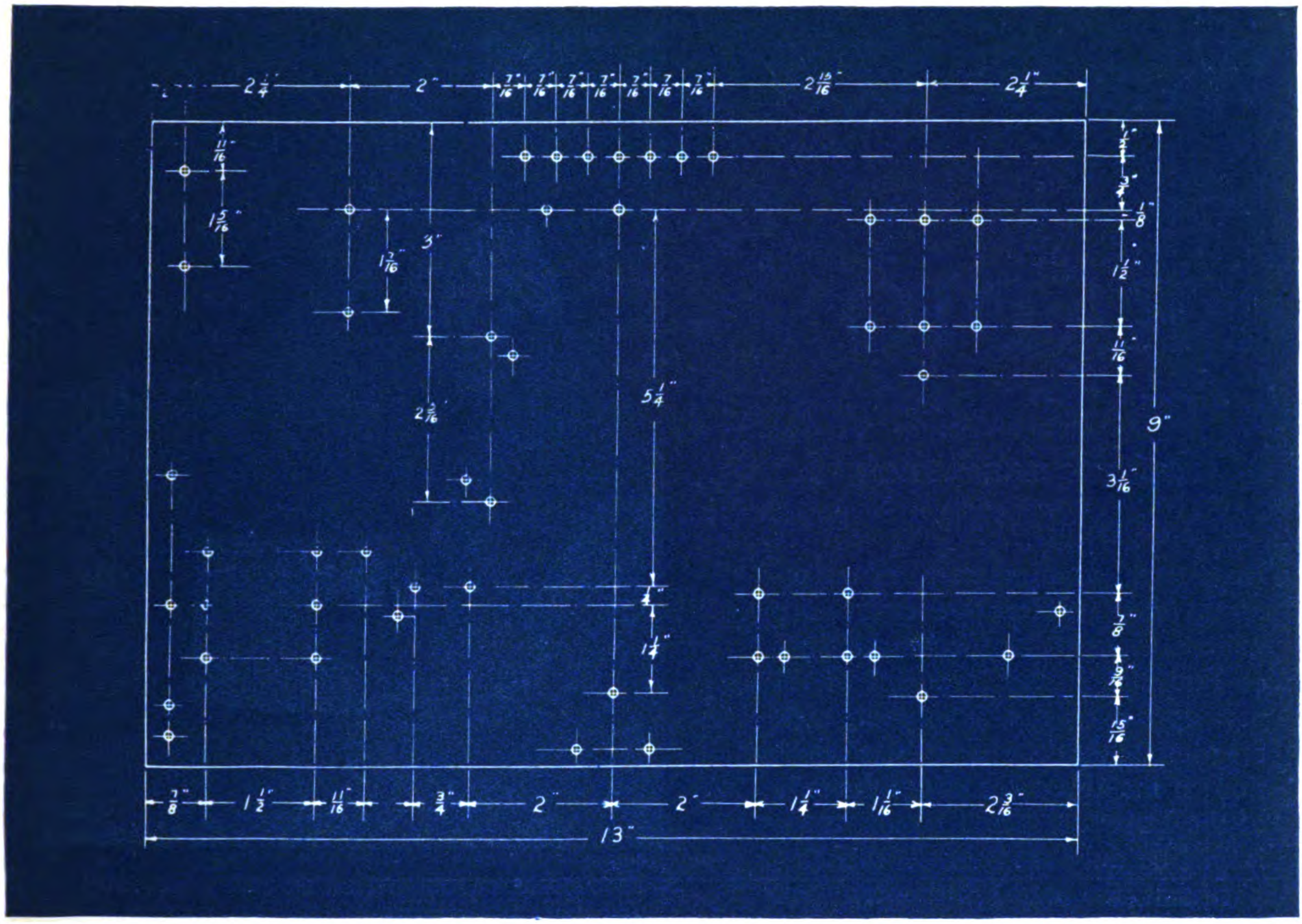
When everything has been connected up as shown in Figure 2, tune in a local station by means of the main tuning control. Then adjust the small compensater knob located in the center of the dial until the station is tuned in fully. The neutralizing condenser should then be adjusted. Generally the proper position will be with the plates interleaved about ¼ of the way. The antenna series condenser should be so adjusted (with plates about ¾

(*Continued on page 360*)



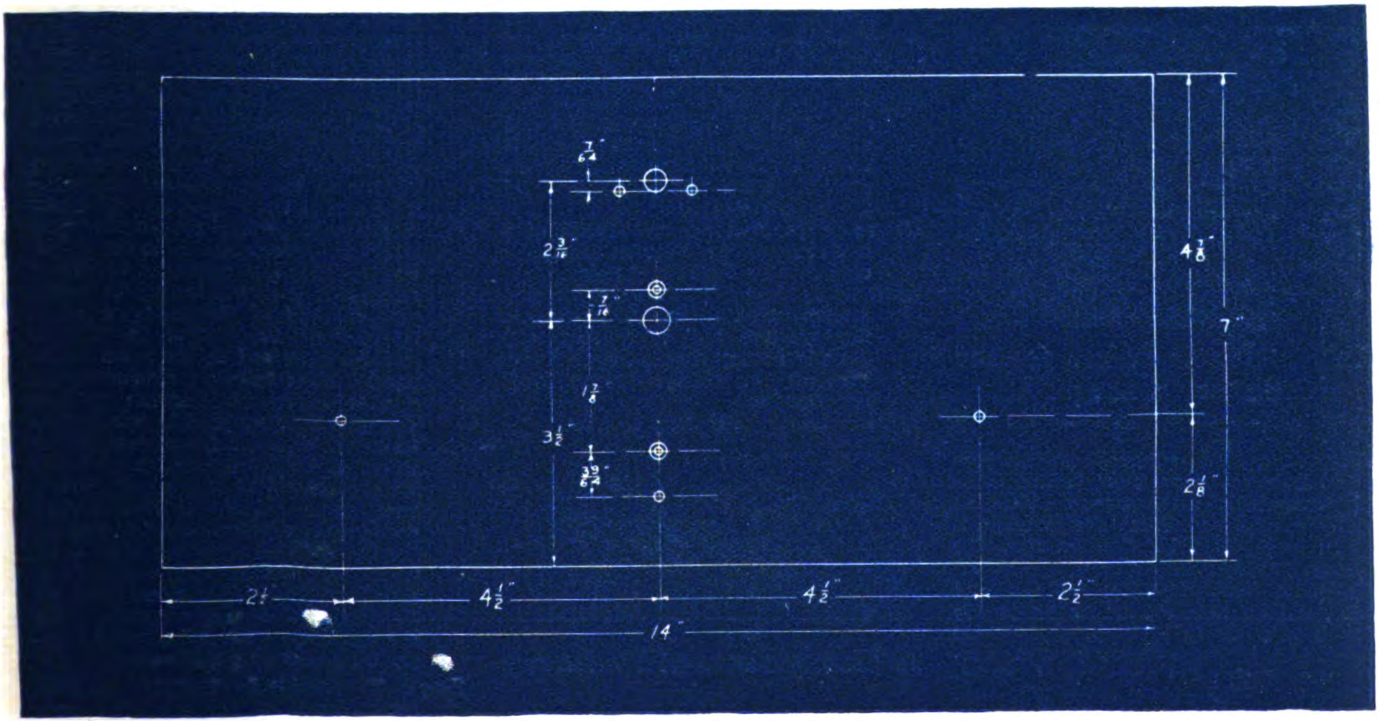
THE UNDER SIDE OF THE SUB-PANEL

FIGURE 5: *The manner of wiring the unit may be seen in this view. Insulated bus wire, such as Celatsite, is convenient to use.*



THE DRILLING PLAN FOR THE SUB-PANEL

FIGURE 6: *This layout shows the exact positions for all of the holes that are to be drilled in the sub-panel for mounting the instruments, sockets and binding posts.*



THE DRILLING PLAN FOR THE FRONT PANEL

FIGURE 7: *This shows the holes that are to be drilled in the panel to mount the variable condensers, the rheostat and the knob for the tuning unit, T2.*

What's New *in* RADIO

Conducted by

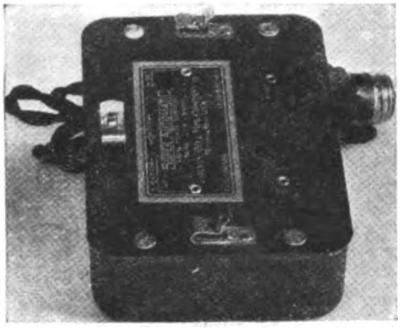
THE TECHNICAL STAFF

Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY, it will be duly recorded in this Department for the information and benefit of all.

From a photograph made for POPULAR RADIO

SLEUTHING INTERFERENCE ON THE ROOF TOPS

This device is a complete portable receiver for use in locating interference from power lines, electric signs, defective wiring, and other electrical disturbances that cause so much trouble in certain radio neighborhoods. It is made by the Davis Equipment Company.



An Automatic Switch for the Battery Charger

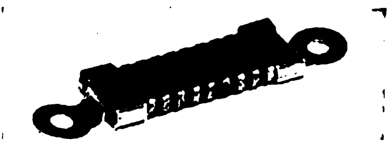
Name of instrument: Automatic power control.

Description: This automatic switch permits a power-operated receiver to be controlled by the battery switch on the receiver. When the receiver is turned "off" by the operator, the unit automatically disconnects the "B" power-pack from the AC line and connects the battery charger to the line so as to replenish the current which has been drawn from the battery during the operation of the receiver. The charger will only be permitted to function until the battery has reached full charge, at which time the control unit automatically turns "off" the charger. The standard 2-ampere or 5-ampere chargers are particularly recommended for use with this unit. The control consists of two separate relays. These are enclosed in a metal case that measures 4⅛ by 5¾ by 2 inches. The top of this case is of composition material and carries the necessary connection terminals and also the receptacles for the plugs from the "B" power-pack and the battery charger.

Usage: To control the power-pack of a receiver and to provide automatic control over battery charging.

Outstanding features: Compact in size. Always keeps battery fully charged. Controls the "B" power-pack and the "A" battery charge automatically. Prevents the storage battery from overcharging.

Maker: Liberty Bell Mfg. Co., Inc.



A Handy Form of Resistance Unit

Name of instrument: Fixed resistance unit.

Description: A composition strip 1⅛ by 3/32 by ⅜ inch is used as the foundation and upon this strip the resistance material, in the form of a flat metal ribbon, is wound. The terminals are in the form of round washers which are clamped directly onto the ends of the wound form. When used for filament control purposes one terminal of the unit may be attached directly to the valve socket and the other end to one side of the "A" battery circuit. Where the sockets are mounted directly on a metal subpanel that is also connected to "A-" terminal it is only necessary to connect one end of the resistance unit to the "A-" terminal of the socket and the other end to the metal subpanel. These units are obtainable in a wide variety of resistance values. The type H is supplied in resistances from 2/5 ohm, for the control of 10 valves of the 201-a type, to 2 ohms, for the control of two of the 201-a type valves. The RU type is for use in series with a rheostat to permit the use of UX-199 valves with a 6-volt supply source. There is also a type T unit which has a resistance of 200 ohms and is center tapped. This is for use across the AC filament supply for power amplifier valves.

Usage: To provide fixed control of filament current, or for any other uses that call for a fixed resistance.

Outstanding features: Small in size. Easy to install.

Maker: Carter Radio Co.

This Filter Choke Handles Unusually Heavy Currents

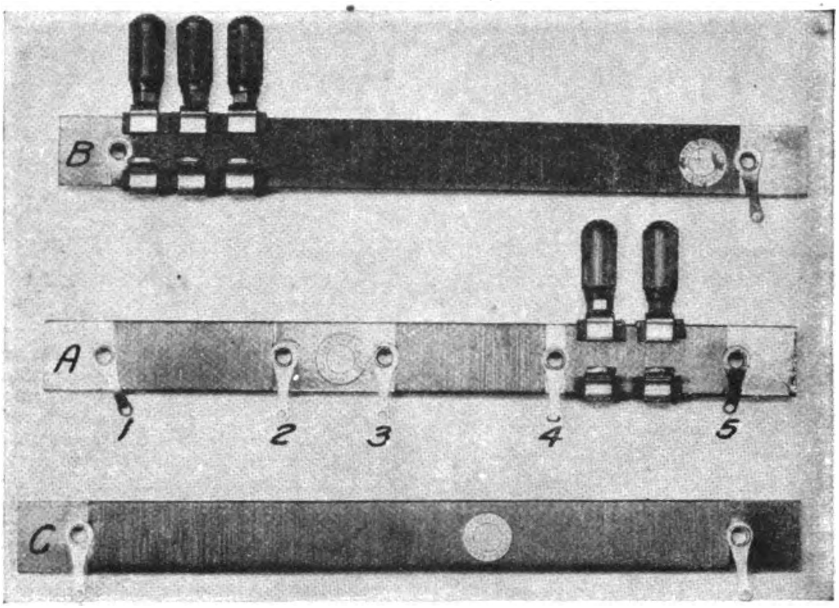
Name of instrument: Double choke No. 3584.

Description: Most of the chokes used in power-pack filters heretofore have been limited in their current-carrying capacity to 100 milliamperes or less. This new choke is capable of carrying up to 400 milliamperes safely. It consists of two chokes, inclosed in a single, crackle-finished iron case. The chokes are connected in series inside of the case and insulated leads are brought out from the common connection and the outer ends of the two windings.

Usage: In conjunction with suitable filter condensers to serve as the filter for an "ABC" power-pack that employs the Raytheon type BA, 350-milliampere rectifier valve.

Outstanding features: Very compact in size for a double choke capable of carrying 400 milliamperes. The two chokes included in this one case provide all the inductance necessary for a filter for this type of power-pack.

Maker: Dongan Electric Mfg. Co.



A Universal Output Resistor for Power-Packs

Name of instrument: Voltage control for "B" power-packs.

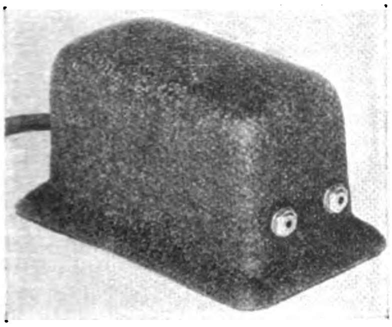
Description: This voltage-control unit consists of two insulating strips 8 inches long by ¾ inch wide by ⅛ inch thick. These are wire wound and when connected into the circuit provide a total resistance of 10,000 ohms across the filter output. In connecting the units in a power-pack, the unit marked A is connected across the filter output with terminal 1 connected to the positive side. Unit B is then connected across from terminal 2 of strip A to terminal 3 to provide three variable "B" voltages which are tapped off at the three sliders. The two sliders between terminals 4 and 5 of strip A provide variable "C" voltages. Terminal 4 is the "B—" connection and terminal 5 is the "C—" maximum connection. The sliders are equipped with screw knobs which, when the proper adjustment of the slider has been made, are turned tight to make the adjustment permanent.

The strip C is provided for use in series with strip A in cases where the output voltage is in excess of 200 volts. It is connected between the positive side of the filter output and terminal 1 of strip A. This unit C is obtainable in various resistance values to take care of output voltages up to 500 volts.

Usage: As the voltage divider across the output of a "B" power-pack to provide variable "B" and "C" voltages to fit the exact requirements of the receiver that is to be supplied by the power-pack.

Outstanding features: A flexible arrangement that can be used with any "B" power-pack with an output voltage of between 100 and 500 volts. The resistors are wire wound and have more than ample current carrying capacity to fit the needs of any power-pack or receiver. Provides variable "B" voltages for the detector, high-frequency and intermediate low-frequency stages of a receiver. Also makes provision for two variable "C" bias voltages.

Maker: Carter Radio Co.



Protect Your Reproducer With This Unit

Name of instrument: "Orthophone" output filter.

Description: This filter unit consists of an iron-core choke coil and a condenser, both of which are inclosed in a one-piece stamped metal case. The overall size is 4⅝ by 2½ by 2⅜ inches. The instrument is supplied with a brown crackle finish. The input terminals are in the form of a double-tipped cord similar to the cord on a reproducer. These are for connection to the receiver output where the reproducer is ordinarily connected. The output terminals of the Orthophone are small tip jacks mounted in one end of the case. The reproducer tips are inserted in these jacks.

Usage: To be connected between the output of the receiver and the reproducer. It is for use with any receiver that employs 135 volts or more on the plate of the last low-frequency amplifier valve, and which does not include an output filter or output transformer.

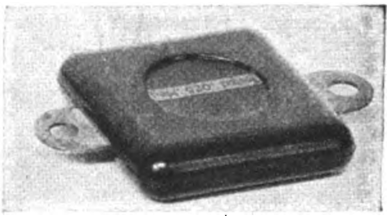
Outstanding features: Small size. Neat appearance. Affords good protection for the reproducer windings.

Maker: Amsco Products Co.

A Fixed Condenser of Substantial Design

Name of instrument: Mica fixed condenser.

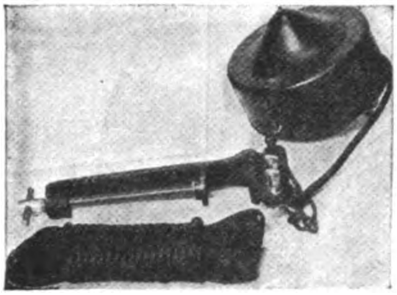
Description: Mica and tinfoil are used in the making of these condensers. After the condenser unit has been built up it is completely sealed in a bakelite case that is moulded under several tons pressure. The terminals are in the form of wide brass strips that project from the ends of the condenser. These brass strips are punched so that the condenser may be fastened under binding posts, or may be attached directly to a valve socket terminal.



Usage: Wherever a fixed capacity of any definite value from .00005 mfd. to .025 mfd. is needed. May be obtained with grid-leak clips in capacities of .0001, .00025 and .0005 mfd.

Outstanding features: Extrememly solid. Not affected by moisture or heat.

Maker: Micamold Radio Corp.



Make Your Piano a Radio Reproducer

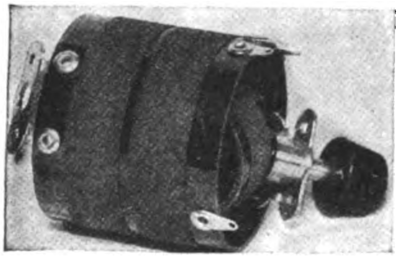
Name of instrument: "Rotofor" radio "piano" reproducer.

Description: This powerful reproducer unit is equipped with a special mounting by means of which it may be securely clamped to the framework of any type of piano. The driving rod, which extends from the front of the unit, is allowed to rest snugly against the sounding board of the piano. It is this rod that carries the reproducing energy from the unit to the piano sound board, causing the latter to vibrate and thus reproduce the broadcast program.

Usage: For the reproduction of radio programs, making use of the piano sounding board as a reproducer.

Outstanding features: Easily installed. Good quality of reproduction.

Maker: International Radio Corp.



A Variable Coupling in Compact Form

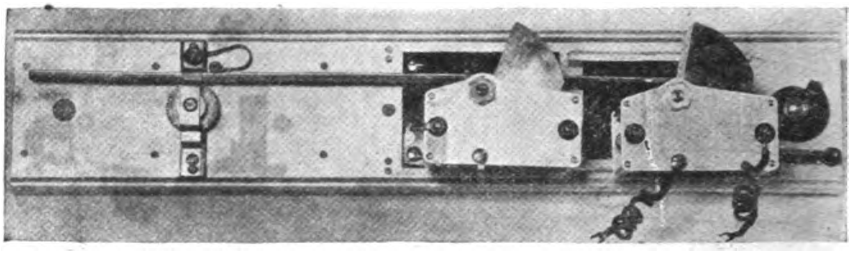
Name of instrument: Coupling coil unit.

Description: This coupler consists of a primary winding and a split secondary winding. The secondary is wound on a bakelite form 2¼ inches in diameter by 2 inches in length. The primary or rotor coil is wound on a short length of 1½ inch bakelite tubing, and is mounted on the stator form in such a position as to permit it to rotate through an arc of 180 degrees. The windings are of green, silk-covered, copper wire. The secondary winding is split into two equal halves, with two terminals brought out from each half. This arrangement makes this coupler adaptable to practically any circuit. Terminals are in the form of soldering lugs and are conveniently located on the rim of the stator form. Pigtail connectors are provided between the rotor coil and its terminals.

Usage: As an interstage coupling unit for use in high-frequency circuits or as an oscillator coupler in a superheterodyne receiver.

Outstanding features: Well made. Compact. Panel or base mounting. Readily adaptable to practically any type of high-frequency circuit.

Maker: Camfield Radio Co.



A Gang Condenser Unit That Simplifies Tuning

Name of instrument: Victoreen master control unit.

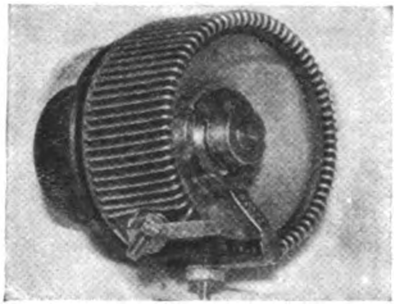
Description: This unit may be obtained in sizes comprising from two to four variable condensers that are mounted on a metal rack, equipped with a sliding gear arrangement that permits the tuning of the condensers by means of a single control shaft. To use this unit in a receiver it is mounted on the inside of the front panel of the receiver. The single-control shaft projects through the receiver panel and the tuning knob or dial is attached thereto. One of the condensers is equipped with an additional sliding-gear arrangement, which permits a compensating adjustment to be made on this one condenser to balance its capacity against that of the other tuned circuits in the receiver. This feature is especially useful when this condenser is connected in the input circuit of the first valve. By means of this balancing adjustment it is possible to make up for the slight variation in circuit values which results from the antenna being coupled to this first circuit.

The condensers in this unit are thoroughly insulated from one another, and any possibility of body-capacity effect in tuning is largely eliminated. The hand, in tuning, does not come in close proximity with any part of the condensers.

Usage: As a complete single-control tuning unit for use with receivers that have from two to four tuned circuits of similar electrical values.

Outstanding features: Provides single-control tuning. The condensers are thoroughly insulated from one another. Permits separate adjustment to be made to compensate for slightly different electrical values in the antenna circuit. Easily installed.

Maker: George W. Walker Co.



Positive Control for the Filament Circuits

Name of instrument: Filament rheostat.

Description: This rheostat consists of a metal frame that supports the resistance winding in a solid manner. The resistance winding consists of wire wound on a composition strip. This device is made in various resistance values, from the Model 775, which is a 75-ohm rheostat, down to the No. 702½, which is a 2½-ohm rheostat capable of carrying 2 amperes continuously. 200 and 400-ohm potentiometers are also made in this style.

Usage: For controlling the filaments of one or more standard vacuum valves.

Outstanding features: Provides a light but firm contact on the sliding arm. Resistance winding uniform and firm. Single-hole mounting.

Maker: Herbert H. Frost, Inc.

A Reproducer with Good Volume and Tone

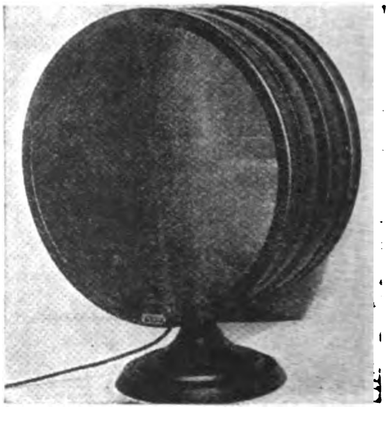
Name of instrument: Drum-type reproducer.

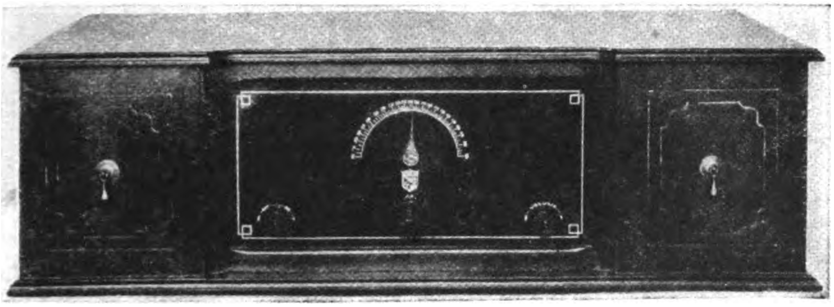
Description: The tone chamber of this unit is made of heavy composition and resembles a 54-inch horn that has been curled up to fit into a small space. The actual length of the air column is 4½ feet, in spite of the fact that the body of the reproducer is only about 15 inches in diameter. The reproducer unit used in this reproducer is one that is capable of handling tremendous volume. The tone chamber is enclosed in a metal case that is open at the front but protected by a silk screen. This whole unit is mounted on a heavy metal base and is equipped with a 5-foot extension cord for connection to the receiver output.

Usage: As a reproducer for use with any radio receiver, especially in cases where large volume is required.

Outstanding features: Great volume and fine tone quality. Capable of handling the output of even the most powerful receivers. Neat in appearance. Good workmanship and very substantial construction.

Maker: Temple, Inc.





A Six-Valve AC Operated Receiver

Name of instrument: Simplex, model B, electric receiver.

Description: This 6-valve receiver comprises two stages of tuned-high-frequency amplification, a detector and three stages of low-frequency amplification. It includes a number of refinements which are of particular interest to the radio fan—such as, for instance, the elimination of all batteries, single-control tuning and the inclusion of the entire receiver and the power-pack in a single cabinet.

The McCullouch type valves permit the use of low-voltage alternating current obtained from the house-lighting lines through a small step-down transformer which is included in the "B" and "C" power-pack. This eliminates the need for storage battery and its attendant charging device. It also simplifies the operation of the receiver.

The high-voltage direct current for the plate supply is obtained from the alternating-current lighting lines through a "B" and a "C" power-pack which is included in a compartment at one end of the receiver cabinet. This power-pack makes use of a Raytheon rectifier valve and provides the three "B" voltages and two "C" voltages required in the operation of the receiver.

The high-frequency amplifier consists of two tuned stages and a tuned detector input. The coupling transformers are small in size and are placed at an angle to one another to reduce undesirable interaction to a minimum. They are tuned by means of three variable condensers which operate together by a belt and pulley arrangement so that a single tuning control knob may be used. Superimposed on this knob is a smaller one which operates a compensating condenser to maintain an exact balance between the various circuits.

To permit just the proper degree of antenna coupling an arrangement consisting of four small tip jacks and a metal-tipped connection wire is provided. By plugging this tip into the different jacks varying degrees of coupling can be obtained and the best coupling for each installation is easily determined.

Sensitivity in the high-frequency amplifier is controlled by means of a variable resistance in the "B" voltage supply line to these two halves. This resistance is installed on the panel and is marked "volume" control. It serves also as an oscillation control and when adjusted so that the amplifier is just below the point of oscillation a high degree of sensitivity may be obtained for distance reception.

The low-frequency amplifier employs three transformer-coupled stages. The transformer windings are of the low-ratio variety. This type is purposely used because of the better quality of reproduction obtainable with a low step-up ratio, and in order to make up for the somewhat smaller amount of amplification obtained with this method an extra stage is used. To provide a means for a certain amount of regulation of volume and tone in the low-frequency amplifier a variable resistance is included across the secondary of the second transformer. This resistance is also mounted on the front panel. It is a combination unit which includes not only the resistance but a switch which turns the receiver "on" and "off."

The cabinet is finished in dark mahogany. The metal front panel of the receiver proper is finished to match the cabinet and the front of the cabinet at either end of this panel is finished in a paneled effect with bronze drawer pulls for decorative effect. The tuning dial is calibrated directly in wavelength.

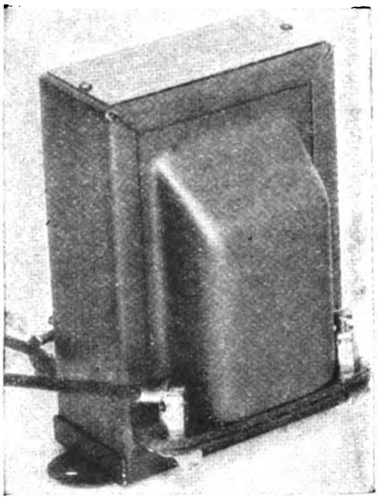
The receiver unit occupies only a part of the interior of the cabinet, and the power-pack is inclosed in a separate compartment at the left-hand end. An extension cord and plug, for connection to any AC light socket, is brought out through a hole in the rear of the cabinet. The antenna and ground connection wires are also brought out at the rear. Tip jacks for plugging in the metal tipped ends of the reproducer cord are included in the receiver unit and the cord is carried in to these jacks through a hole provided in the rear. These four connectors are the only external connections required. Under certain conditions an antenna is not required. Instead of the antenna connection, wire from the receiver may be connected directly to a special binding post provided on the power-pack. This permits the use of the electric light wires as an antenna.

The operation of the receiver is very simple. The power is switched "on" by means of the switch knob at the lower left-hand corner of the front panel. A brief period of time is allowed to elapse while the valve elements are warming up (about 30 seconds) and the receiver is then ready to tune in stations with the tuning knob in the center of the panel.

Usage: For the reception of radio broadcast programs.

Outstanding features: Requires no batteries. Receiver and power-pack included complete in the single cabinet. Single control tuning. Under certain conditions no antenna is required.

Maker: Simplex Radio Co.



An Output Unit That Protects the Reproducer

Name of instrument: Output transformer, Superaudioformer type No. 27-B.

Description: In size and appearance this transformer is an exact duplicate of the Superaudioformer No. 27-A, and these two types are intended for use in the same amplifier. The primary winding of this output transformer is capable of carrying up to 40 milliamperes and it is therefore suitable for use in power amplifiers that employ UX-171 or UX-210 types of power valves in the last stage. The secondary impedance is correct to match the impedance of present-day reproducers.

Usage: As a coupling device to be connected between the plate circuit of the last low-frequency amplifier valve and the reproducer.

Outstanding features: Suitable for use with high voltages and high plate currents. Properly matched with reproducers in impedance. Good construction and design.

Maker: Pacent Electric Co., Inc.

Jacks for Use Where Space Is Limited

Name of instruments: Gem-Jacs.

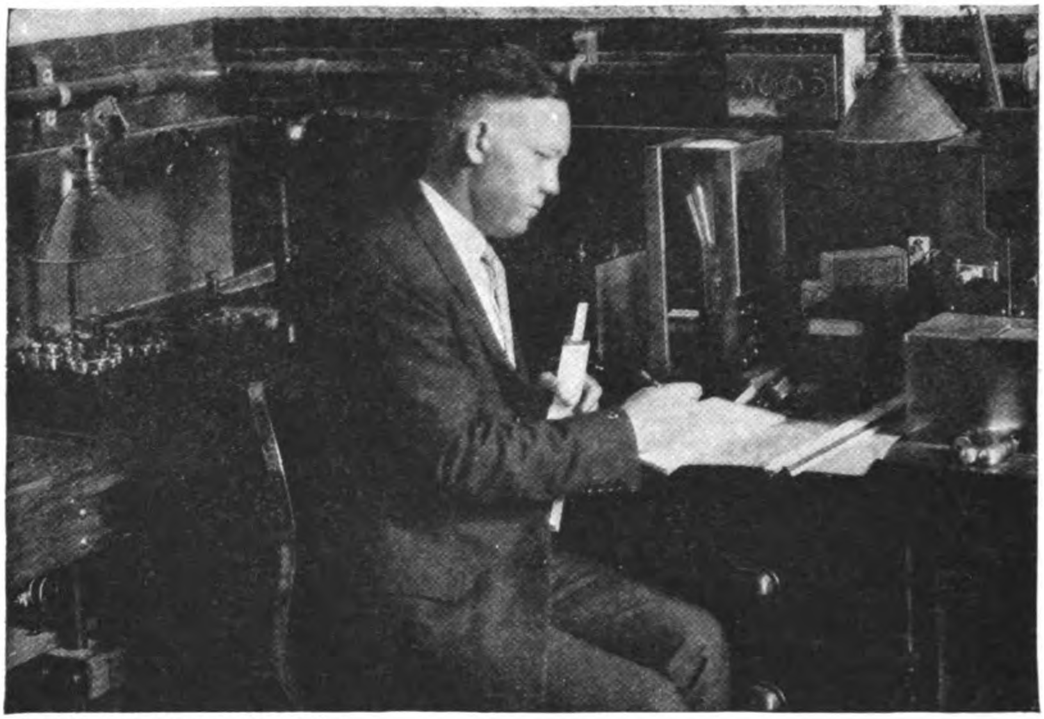
Description: These jacks are extremely small in size. When mounted in a receiver they occupy panel space 1 inch high by 1 inch wide and extend back 1 inch from the panel. They are obtainable in single and double-circuit types, both open and closed. They are built up around a heavy "U" shaped metal frame, are well insulated and equipped with tinned extensions which serve as soldering lugs.

Usage: As an output terminal device where connections are to be made by means of a phone plug.

Outstanding features: Compact in size. Extremely rugged in construction. Easily mounted and easily wired.

Maker: Herbert H. Frost, Inc.

(*Continued on page 390*)



From a photograph made for POPULAR RADIO

HE RECORDS THE LIVES OF VACUUM VALVES

Here is the author of this article in a corner of the laboratory where he made the tests which are described below.

HOW RADIO FANS CAN LEARN TO READ

The Autobiographies of Valves

To many radio fans a vacuum valve is merely a complicated sort of electric bulb that "lights up" when used in a receiving set. But there are many electrical characteristics of valves that can neither be seen nor heard, but which are most important in determining how a valve will work. The methods of determining these qualities scientifically, and their effect on the operation and life of the valve, are described in this article by—

H. A. McILVAINE, E.E.

FEW developments of modern times have been more rapid and few successful productions have been fraught with more variables than those of the vacuum tube (more correctly known as the vacuum valve). Yet the electrical constants and characteristics of the valve have been understood little by the average experimenter.

We hear of "matched valves" and "high mu" valves for low-frequency amplification, and low-loss, hard and soft valves. One manufacturer says that one should buy "low impedance" (meaning plate to filament) valves, while another advertises, "I have the valves with the highest plate impedance."

As a matter of fact there are so many electrical properties of vacuum valves which are not yet fully understood that it is difficult to obtain a numerical rating which will enable one to predict how a valve will act in any given position, in any given set and under any given set of condititons.

However, many vacuum valve characteristics are understood in a general way and this knowledge may be used to predict the action of a valve under certain conditions. By "certain conditions" are implied not only the set used, the position of the valve in the set, the wavelength that is being received, the antenna-ground system or loop and the weather conditions, but also the actual voltages applied.

For example, most of the electrical characteristics of the valve have a meaning only when the plate, grid and filament voltages are specified.

One of the important factors in valve operation is cathode efficiency. The thoriated filament UX-199 type of valve, for example, is highly efficient at 3.0 volts and .06 amperes or .18 watts filament power-consumption, and several valves may be economically run from a dry "A" battery. Its electron emission efficiency is about 45 milliamperes per watt at its normal operating temperature of 2000° Kelvin during its normal life.

The old tungsten filament valves, like the UV-201 type, had only 1.6 milliamperes per watt electron emission—a much smaller operating efficiency.

The operating temperature of the thoriated filament valve is so low that the end of its life is not determined by a burned-out filament, as is the case with the high-temperature tungsten filament lamp, but rather by a loss of electron emission. This results from the evaporation of the film of thorium from the surface of the tungsten, which in turn is caused by a bombardment by gas particles or by an insufficient amount of the metallic thorium. Consequently, one of the simplest and most important tests on a thoriated filament valve that is suspected of being "dead" is to measure its electron emission.

If the electron emission is good, the gas pressure *cannot be very high*. The plate current, impedance, mu, and other factors which are limited by the geometry of the valve must be all right. In short, the valve must be good in all of its characteristics, if it was all right in the first place. The end of life is determined by the loss of the emitting surface.

It might be well to add that reliable vacuum valves stand up remarkably well and that they are blamed many times when the set or the batteries are at fault.

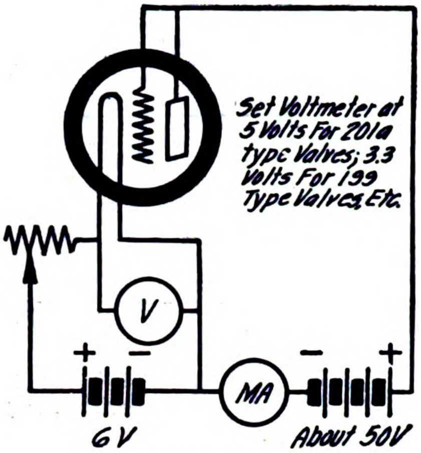
The valve may be checked very easily with the set-up shown in Figure 1.

The grid and plate are first tied together so as to reduce the space charge. The grid-plate system will then collect most of the electrons in the UX-199 and 201-a types of valves when 50 volts is applied between the plate and grid system and the filament, the latter being at normal temperature. For the plate current is a function of grid and plate voltages such that

$$I_p = f\ (E_p + \mu E_g)$$

Putting the relatively high voltage of 50 volts on the grid is equivalent to putting mu x 50 on the plate, added to what is already on the plate. This emission value should be enough greater than the plate current which ordinarily flows under conditions of maximum plate, grid and filament voltage to insure that no distortion will occur on loud signals. If the total electron emission is less than this value, the valve may be considered useless, as the signals will be weak and their wave crests will be rounded off.

Let us assume that there is a sufficient emission of electrons and that the valve is limited only by space charge. This is the best condition for the type of valve that is ordinarily used for radio reception and transmission. The plate current flowing from the filament to the plate quite naturally depends upon the filament-to-plate impedance, which is the resistance to the flow of plate current.

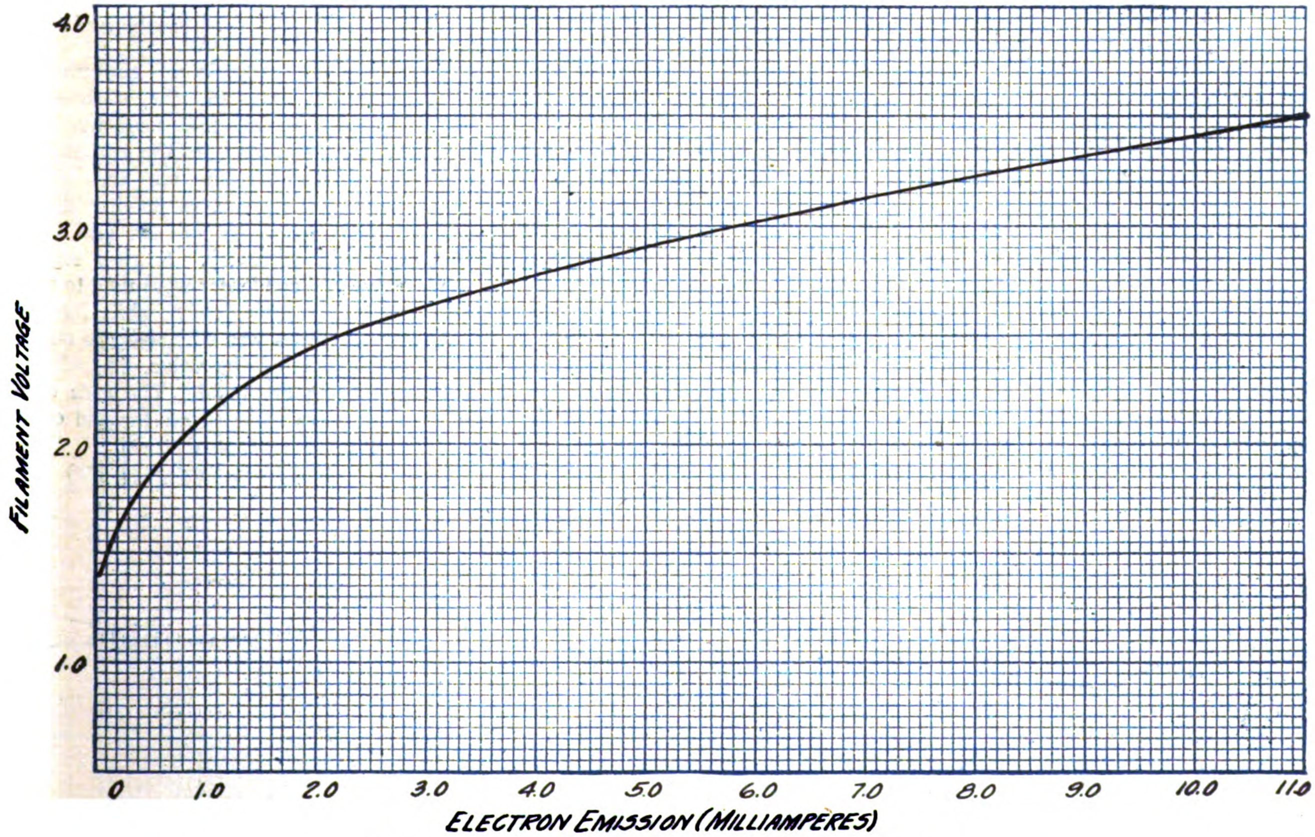

Set Voltmeter at 5 Volts For 201a type Valves; 3.3 Volts For 199 Type Valves Etc.
V
+
-
MA
-
+
6 V
About 50V

A TESTING HOOK-UP

Figure 1: *This circuit is used in testing the emission characteristics of a vacuum valve. The emission is read in milliamperes on the meter MA.*

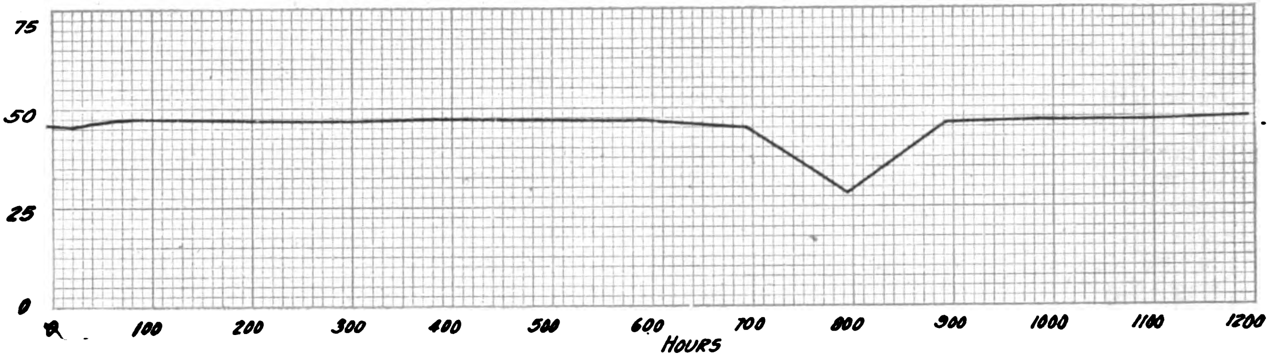
But in a valve the impedance itself changes with the conditions.

For example, if there were no electron emission the impedance would be great and would be equal to the impedance of an open circuit.



THE EMISSION CURVE ON A UX-199 TYPE VALVE

Figure 2: *Here is shown the combined results of a series of tests on a number of UX-199 type valves, showing the electron emission with varying values of filament voltage. A test such as this can be made on the set-up illustrated diagramatically in Figure 2.*



THE FILAMENT EMISSION LIFE CURVE OF A UX-201-a TYPE VALVE

FIGURE 3: *The plate current is recorded in milliamperes, with the grid and plate tied together for a period of fifty days.*

But this factor is eliminated by keeping the electron emission higher than is necessary. The valve is then said to be limited only by space charge and the impedance is changed only by the charge in the space between the plate and the filament.

The geometry of the valve will affect the plate impedance and therefore the plate current.

For a given valve, the plate and grid voltages (assuming the filament voltage to be normal), will affect the impedance and plate current. That is, the impedance will decrease as the plate and grid system voltages rise. Thus, if valves are to be matched for plate impedance with their operating circuit, the voltage under which the impedance is taken must be specified. The voltage of the plate and grid system is

$$E_{pg} = E_p + \mu E_g$$

The amplification factor, mu, depends upon the geometry of the tube and is affected much less by the voltage of the plate and grid system.

The mutual conductance is usually taken as the ratio mu over Ri; that is, the ratio of the voltage amplification constant over the output impedance. These are usually measured on the Miller bridge at light loads and low frequencies. Consequently, this is a measure of the light load amplification power of the valve and may or may not represent what the valve will do under a heavy load.

There is another factor which better represents the stage voltage amplification of an amplifier stage. This factor is known as

$$A_v = \frac{M_u}{\left(\frac{R_i}{R_x} + 1\right)}$$

Where A_v = voltage amplification
M_u = the voltage amplification factor of the valve
R_i = the internal filament to plate resistance in ohms
R_x = the external circuit impedance in ohms

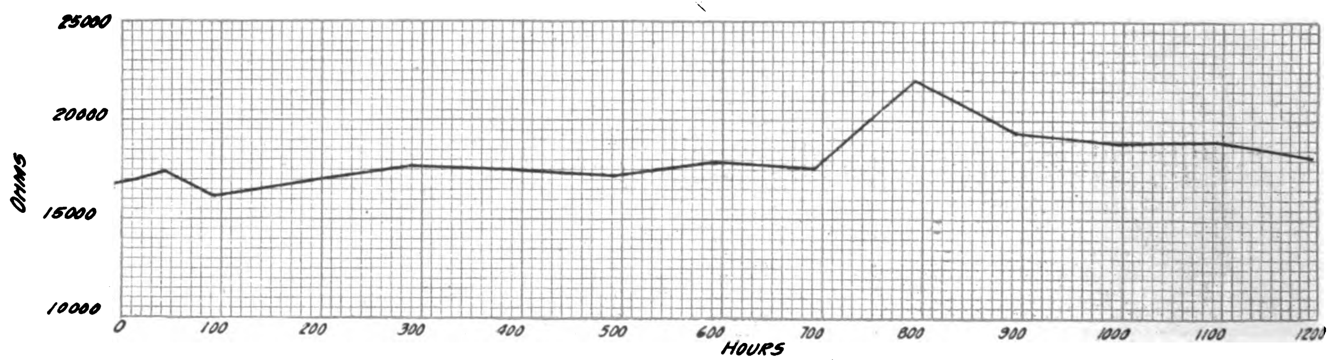
An interesting conclusion which we may draw from this formula is the fact that if we make Rx a tuned impedance which is high, we may make Ri and therefore mu high. Av therefore approaches the mu of the valve. In other words, we desire to have mu high. But to make mu high Ri also rises and offsets the high mu. But if we make Rx high also, then we may make Ri high without losing amplification.

We usually read Av directly on the cathode ray oscillograph, which is an electron gun. The electrons come from a cathode, pass through the gun barrel which consists of a small metal tube, positively charged with respect to the cathode, and the stream is then converged to a small round pencil by passing through a negatively charged ring. After passing between two sets of electrostatic plates, so placed that one pair switches the electron beam one way and another pair at ninety degrees with respect to the first pair, the beam lights up a small spot on a fluorescent screen. It will be seen readily that the spot will travel rapidly about the screen, causing a figure to be seen by the eye.

One of the big advantages of the cathode ray oscillograph is that its moving element has practically no inertia at ordinary or high frequencies. Thus, in order to measure the high-frequency amplification of a stage, we first put the input voltage and then the output voltage on a pair of plates and the difference in length of the two lines is the amplification Av.

Another example of the many interesting uses of the cathode ray oscillograph was that used by Mr. E. W. Ritter to measure the grid and plate current distortion on the UX-240 valves, using valves having different contact potentials on the grid (different grid currents). A glow regulator valve and condenser were used to spread the wave periodically, while the other set of plates was connected to the output circuit of the valve, 60-cycle voltage being amplified. The ends of the wave were chopped off for grid current and plate current distortion.

(*Continued on page 376*)



THE PLATE IMPEDANCE LIFE CURVE OF A UX-201-a TYPE OF VALVE

FIGURE 4: *This chart gives an indication of the variation of the plate impedance of a standard valve during 1,200 hours of its life.*

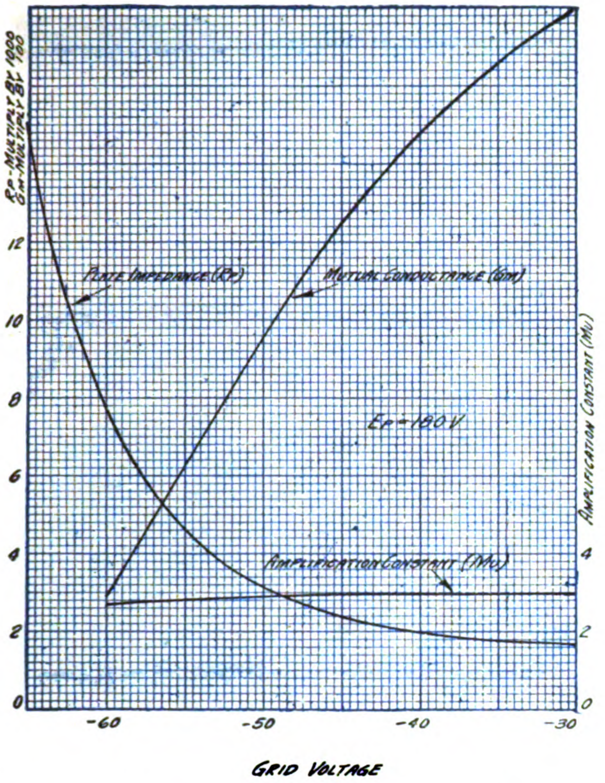


FIGURE 5: *The curves above give the average characteristics for UX-171 type valves, including the plate impedance, the mutual conductance and the mu.*

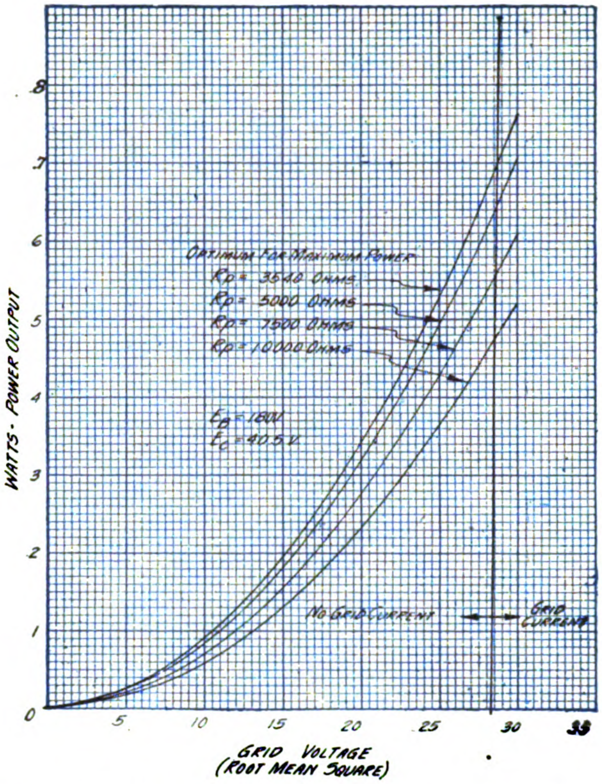


FIGURE 6: *These curves give the average alternating-current characteristics for undistorted output of the UX-171 type valves.*

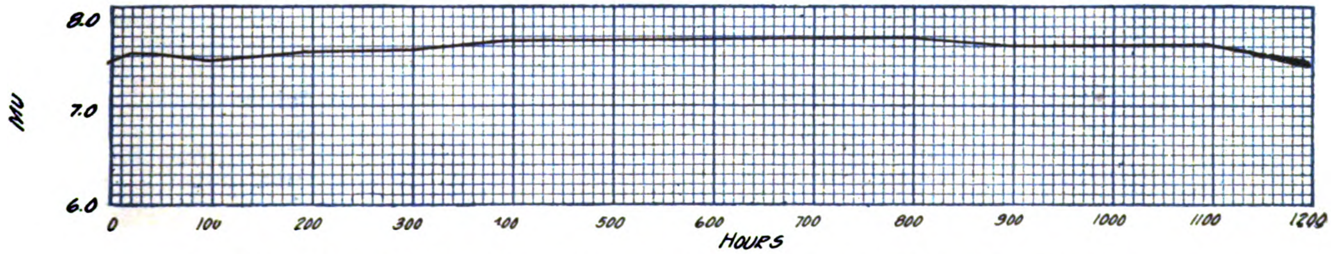


FIGURE 7: *This curve, taken over a period of 1,200 hours, shows the uniform mu maintained throughout the range by a standard UX-201-a type valve.*

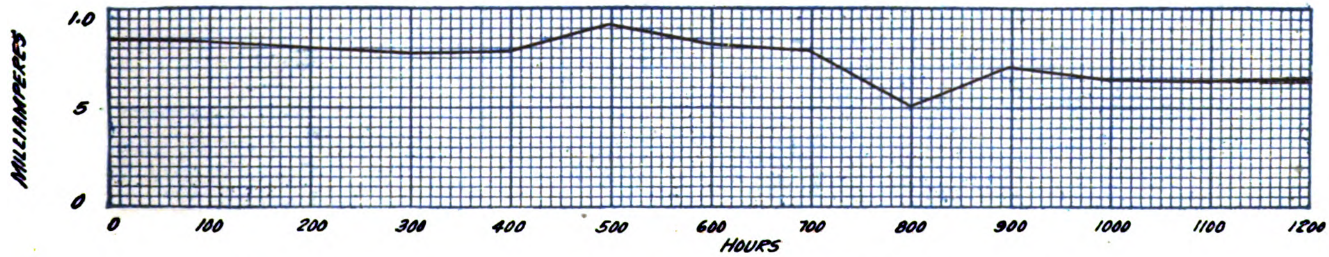


FIGURE 8: *The plate current in milliamperes of a standard UX-201-a type valve is plotted against hours of life, showing the behavior of the valve from this point of view during a fifty day period.*

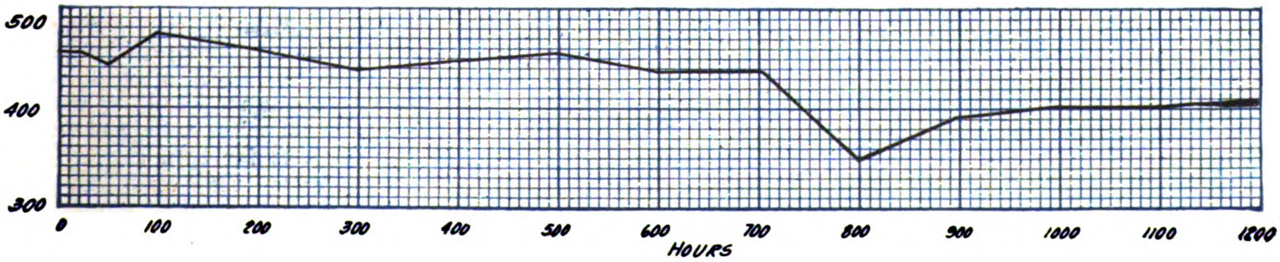


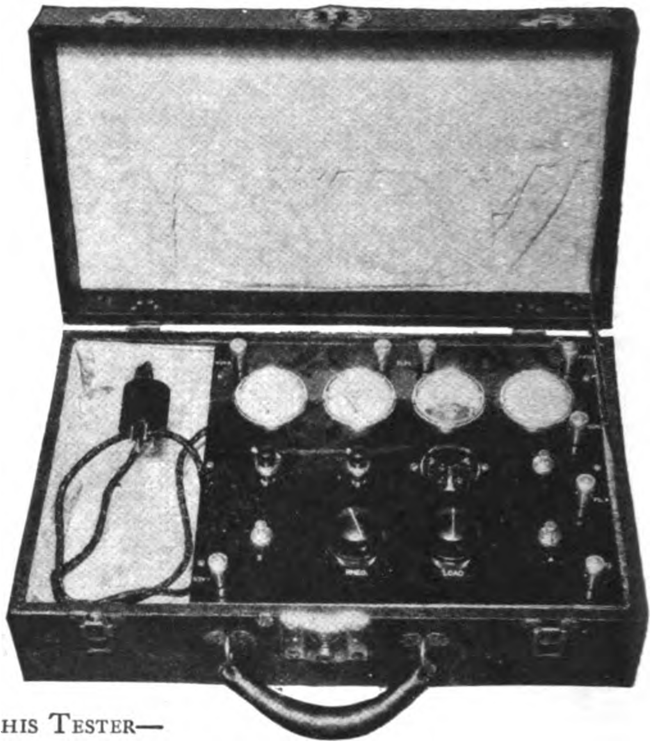
FIGURE 9: *This curve was made on a standard UX-201-a type valve, and shows the variations of mutual conductance, in micromhos, during a period of fifty days.*

HOW TO BUILD AND OPERATE THE

Universal Tester

Here is a radio "Sherlock Holmes" that will ferret out your radio difficulties with ease and precision. It will not only test the emission of vacuum valves, but it also enables the user to discover the functional disorders of receivers and power-packs. And it is quite easy to construct and will not cause any great strain on the builder's pocketbook.

By MORRIS M. SILVER



Cost of Parts: *Not over $34.00*

Here is a List of Parts Necessary for Building This Tester—

M1—Sterling panel type milliameter, 0-50 DC, type R-1626;

M2—Sterling panel type voltmeter, 0-300 DC, type R-415 equipped with 50,000 ohm resistor;

M3—Sterling panel type voltmeter, 0-120 DC, type R-642;

M4—Sterling panel type voltmeter, 0-8 DC, type R-641;

S1, S4 and S5—Cutler-Hammer filament switches, type 8008;

S2—Yaxley two-way, two-circuit switch, No. 60;

S3—Yaxley double-circuit switch, No. 40;

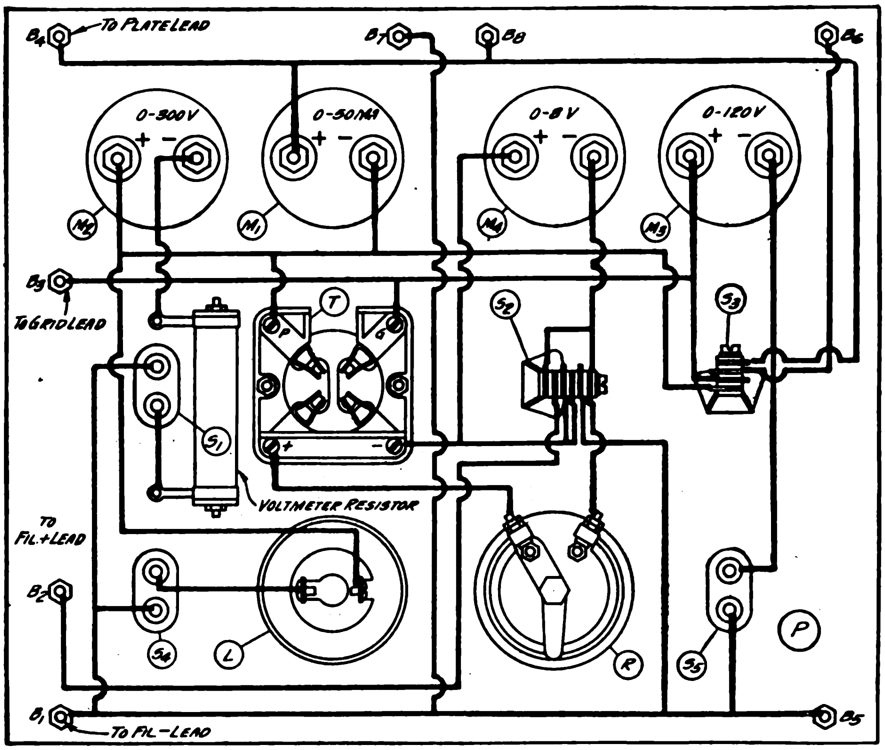
R—E-Z Stat rheostat, 20 ohms;

L—Power Clarostat, universal range, carrying capacity 40 watts;

T—Airgap socket, UX type;

P—Composition panel, 8-7/8 inch by 3/16 inch by 11 inches;

B1, B2, B3, B4, B5, B6, B7 and B8—X-L binding posts.



HOW TO WIRE THE TESTER

Figure 1: *The instruments are outlined in* BLACK *lines, and the wiring is indicated in* RED *lines. All the wiring is done under the panel of the tester.*

It is the experience some time or other of nearly every set builder, radio owner, or repair man, to have a set become stubbornly inoperative for causes that are seemingly difficult to trace. And successive cut and try methods of detecting the trouble frequently lead to nothing but exasperation on the part of the trouble hunter.

In dealing with such conditions, the author has used a simple device of his own design that makes it possible to investigate intelligently many of the operating characteristics of receivers, vacuum valves or power-packs. The construction and operation of this universal tester and trouble shooter are so simple that any radio fan who has frequent occasion to test defective radio apparatus would do well to build one for himself.

In order to make clearer the possibilities of this instrument, seven uses to which the tester may be put are enumerated below:

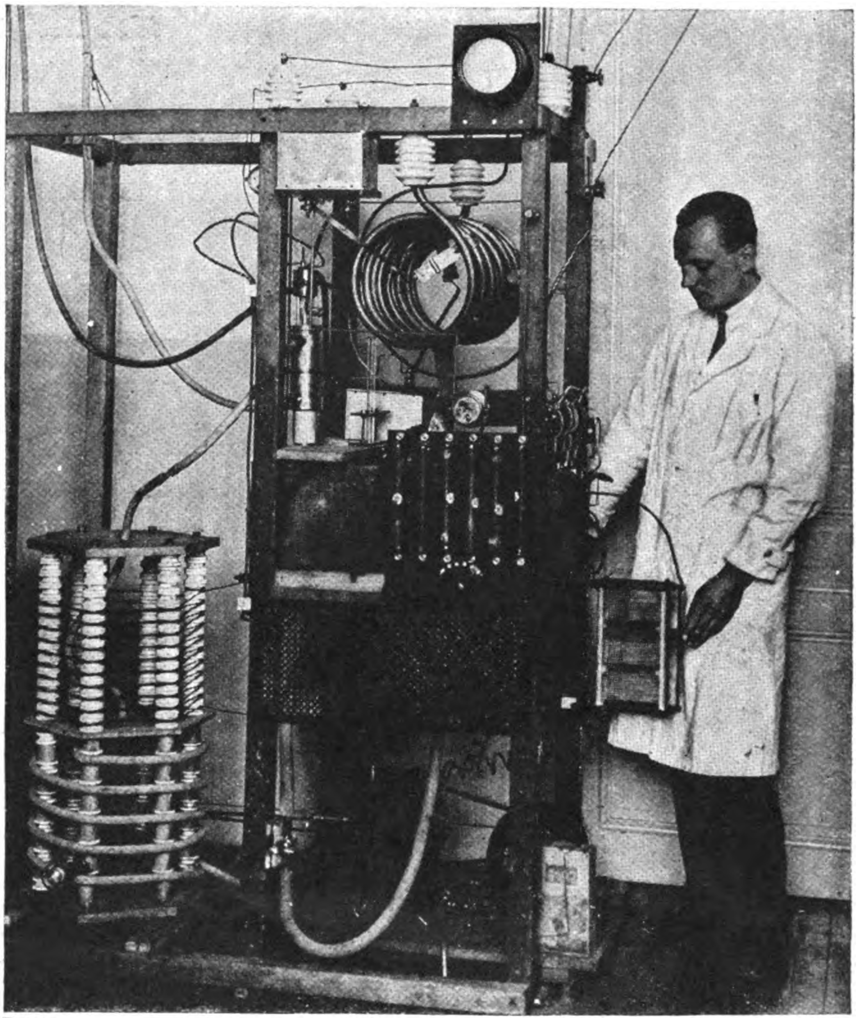
1. Tests vacuum valve rating by reading filament emission.
2. Shows the condition of a radio circuit at any given valve by determining (a) filament voltage, (b) plate current.
3. Gives power-pack voltages and currents at any load or at the normal load of the receiver being tested.
4. Determines voltage of batteries.
5. Tests for open circuits.
6. Tests the condition of condensers.
7. Permits any meter to be used separately.

(*Continued on page 362*)

The New Belin Televisor

EDOUARD BELIN has been one of the most persistent experimenters in search of the ultimate solution of television, and his latest contribution involves many interesting new features. To provide for the more rapid transmission of photographs, Belin has applied several new principles to the problem. By projecting a beam of light from a powerful arc lamp and reflecting it through a small pair of oscillating mirrors, one of which sends the beam forth with a horizontal motion, and the other with a vertical motion, this ingenious experimenter has been able to speed up the process and greatly reduce the time element involved. Upon leaving the image to be transmitted, the agile beams strike a sensitive photoelectric cell mounted within the large cylinder shown in the photograph. Thus the light and dark spots on the image, whether moving or inanimate, cause changes in the electrical resistance of the cell, and this, in turn, is used to modulate the carrier wave of the special short-wave transmitter.

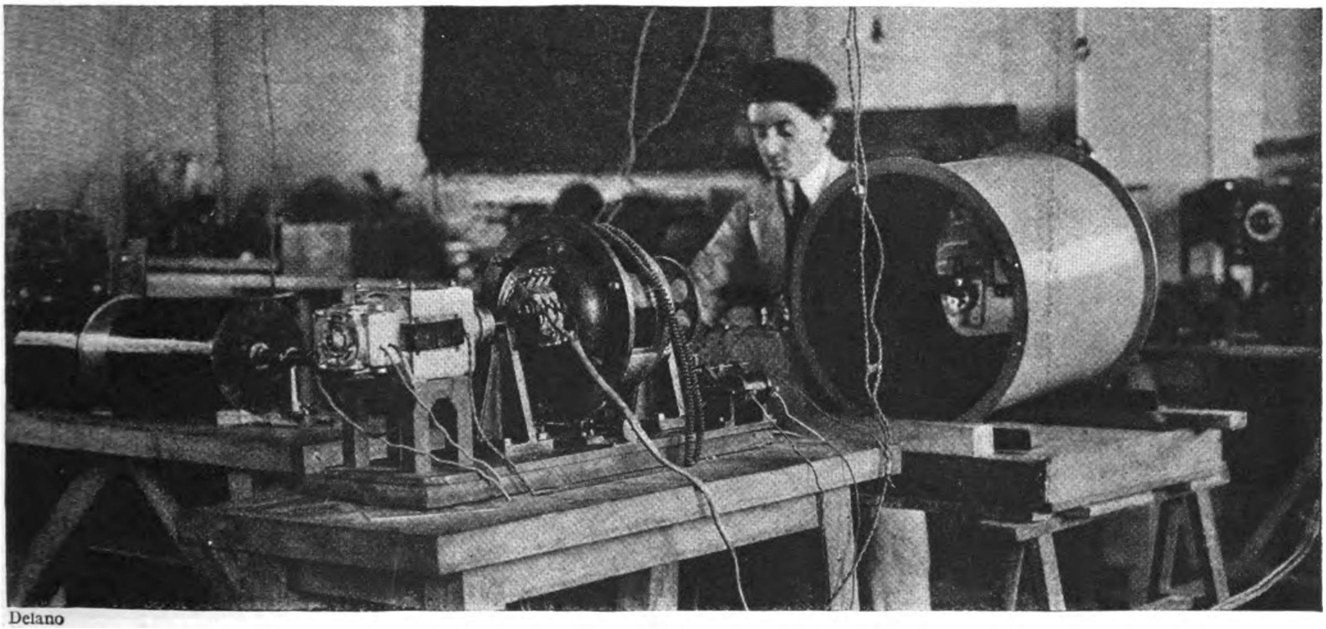
In this development Belin has found that the short waves make more effective transmitters of television impulses than do the longer ones, and the transmitter shown at the right has an adjustable wavelength ranging from 30 to 250 meters. Since Rangers' work most of the experimenters in television have favored the use of the shorter wavelengths, and even ultra-high frequencies have been used with success.



Delano

A SHORT-WAVE TRANSMITTER FOR TELEVISION

This 30-250 meter short-wave transmitter makes use of Holweck demountable valves (seen to the left of the aerial inductance); hence the water-cooling system shown in the picture here is necessary.



Delano

THE ELECTRICAL EYE OF THE BELIN TELEVISOR

By the use of rapidly moving beams of light and a photo-electric cell, Belin modulates the wave of his transmitter with reflected light from the images to be transmitted. The oscillating mirrors may be seen back of the dynamo and below the large cogwheel.

Ace High Quality at Deuce Low Cost With—

The Lynch "Five" Receiver

By S. GORDON TAYLOR

Tone quality that will please the most discriminating ear—constructive simplicity within the abilities of the novice at set building—cost within the reach of the thinnest pocketbook—with these merits the Lynch "Five" should fill a need in the radio construction field that has long been desired and seldom before attained.

COST OF PARTS—*Not over $37.00*

HERE IS A LIST OF PARTS FOR BUILDING THIS RECEIVER—

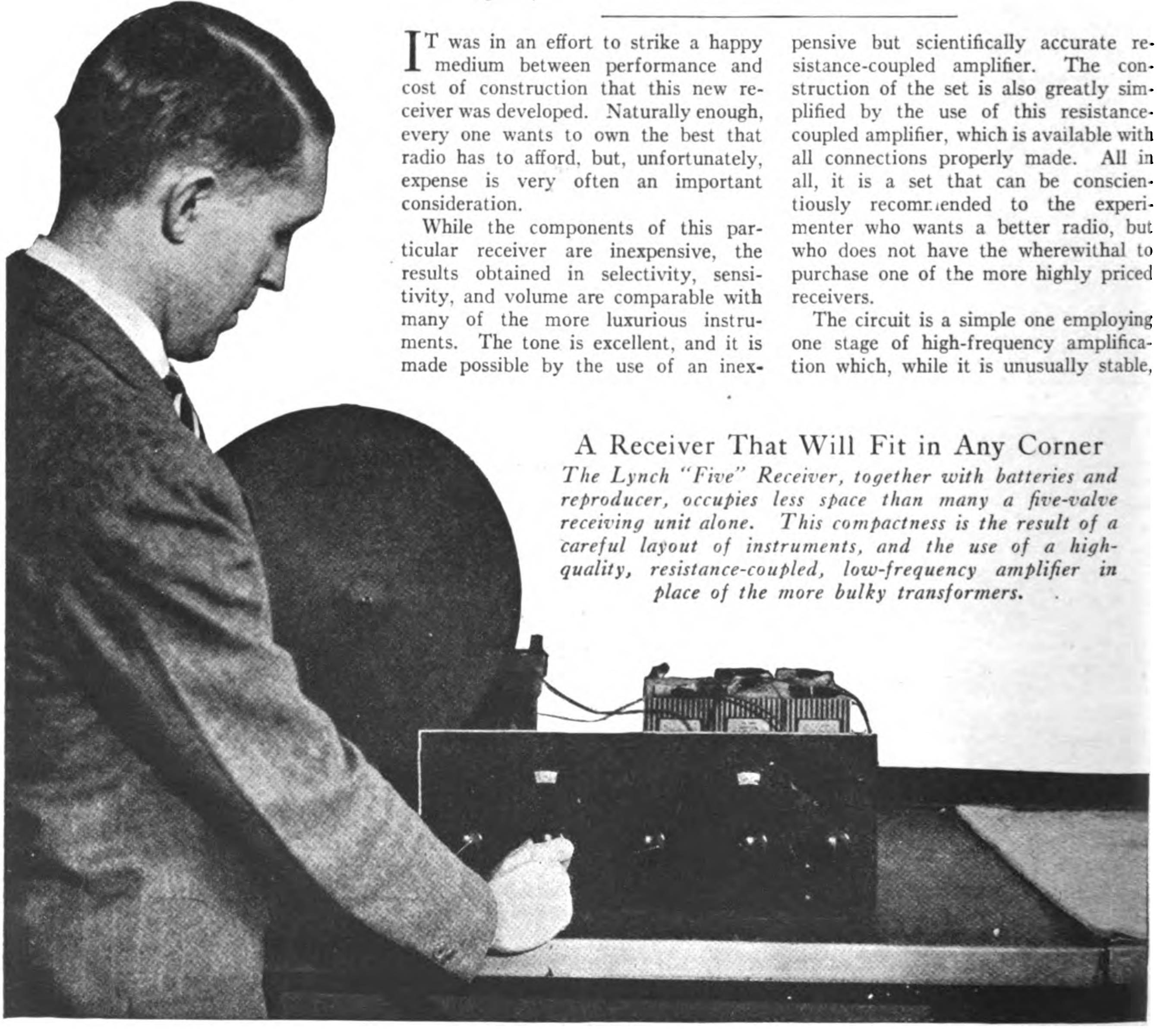
A—Precision antenna tuner, type 3-C;
B—Precision junior tuning unit, type 3-B;
C and D—WRC variable condensers, .0005 mfd.;
E—Carter midget rheostat, 3 ohms;
F—Lynch suppressor, with mounting, type 500;
G1, G2, G3, G4 and G5—Eby DeLuxe sockets;*
H—Lynch metallized resistor, 2.5 megohms;*
I—Lynch special cartridge grid condenser;*
J, K and L—Lynch metallized resistors, .1 megohm;*
M, N and O—Lynch metallized resistors, .5 megohm;*
P—Aerovox moulded mica condenser .0005 mfd.;
Q, R and S—Lynch special cartridge coupling condensers;*
T1, T2, T3, T4, T5, T6, T7, T8, T9 and T10—Eby binding posts;
U—WRC Universal panel, 7 by 18 inches, equipped with Glodials;
V1 and V2—Benjamin adjustable radio shelf brackets;
W—Westinghouse Micarta sub-panel, 6 by 12 inches;*
Wire, screws, solder, etc.

*NOTE: These instruments may be obtained completely mounted on the Lynch Five-valve DeLuxe deck.

IT was in an effort to strike a happy medium between performance and cost of construction that this new receiver was developed. Naturally enough, every one wants to own the best that radio has to afford, but, unfortunately, expense is very often an important consideration.

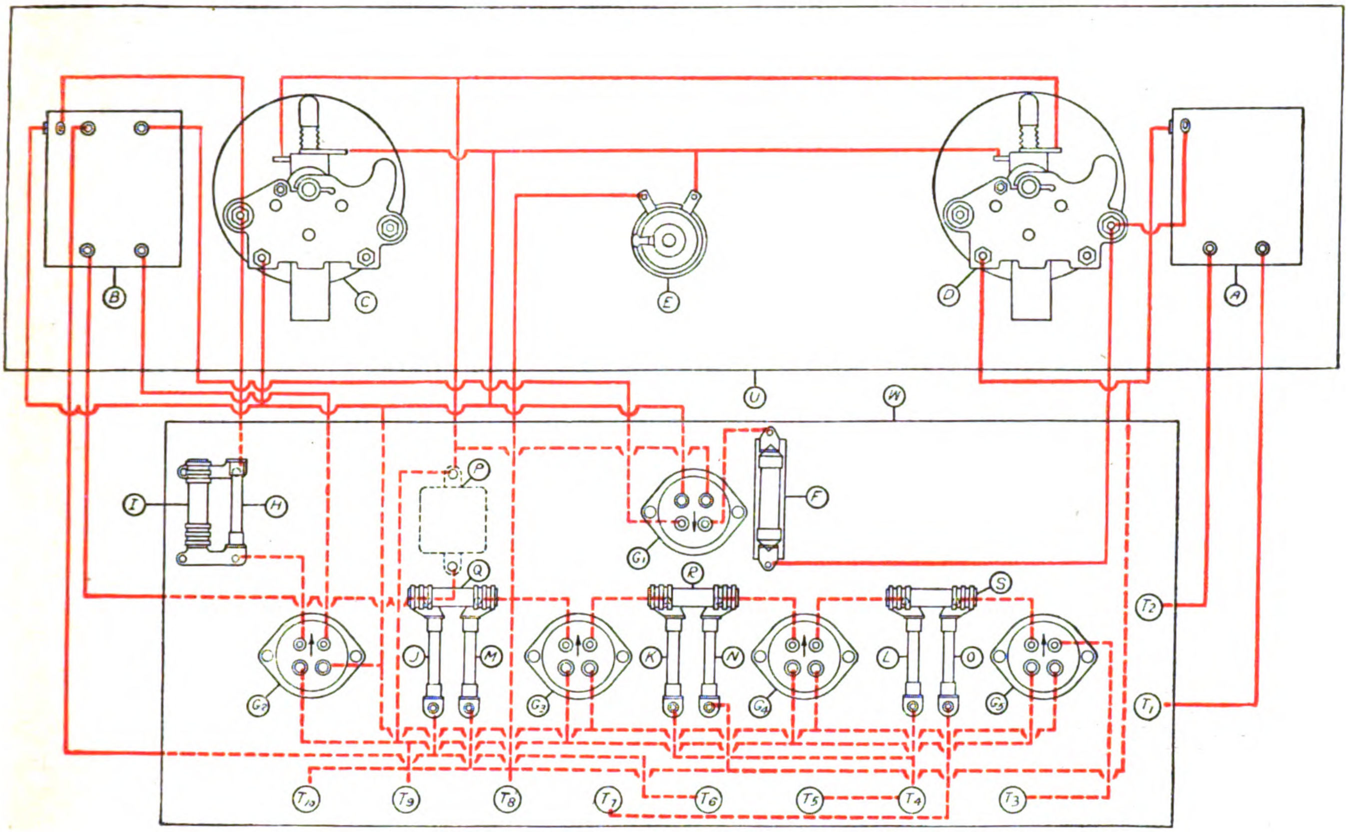
While the components of this particular receiver are inexpensive, the results obtained in selectivity, sensitivity, and volume are comparable with many of the more luxurious instruments. The tone is excellent, and it is made possible by the use of an inexpensive but scientifically accurate resistance-coupled amplifier. The construction of the set is also greatly simplified by the use of this resistance-coupled amplifier, which is available with all connections properly made. All in all, it is a set that can be conscientiously recommended to the experimenter who wants a better radio, but who does not have the wherewithal to purchase one of the more highly priced receivers.

The circuit is a simple one employing one stage of high-frequency amplification which, while it is unusually stable,



A Receiver That Will Fit in Any Corner

The Lynch "Five" Receiver, together with batteries and reproducer, occupies less space than many a five-valve receiving unit alone. This compactness is the result of a careful layout of instruments, and the use of a high-quality, resistance-coupled, low-frequency amplifier in place of the more bulky transformers.



THE PICTURE WIRING DIAGRAM OF THE RECEIVER

FIGURE 1: *The simplicity of the wiring of the receiver may be gathered from this diagram. The instruments are outlined in* BLACK; *the wiring on the front panel and above the sub-panel is indicated in solid* RED *lines, and that below the sub-panel in dotted* RED.

will give added sensitivity to the detector circuit. Two tuning controls with illuminated dials connected to two inexpensive variable condensers are used, together with a control for regulating the volume.

The receiver is to be used with an ordinary single-wire antenna, such as can be easily installed on any apartment or private residence. It may be built by even the most inexperienced in an evening, and set up and placed in operation in time to receive the programs from the broadcasting stations before they turn off for the night.

The only tools necessary for building this set are a drill, a pair of pliers, a screw-driver, a knife and a soldering iron.

The resistance-coupled amplifier has three stages of amplification, which provide excellent tone quality and which will operate the loudspeaker satisfactorily with ample volume for the ordinary home.

How to Construct the Receiver

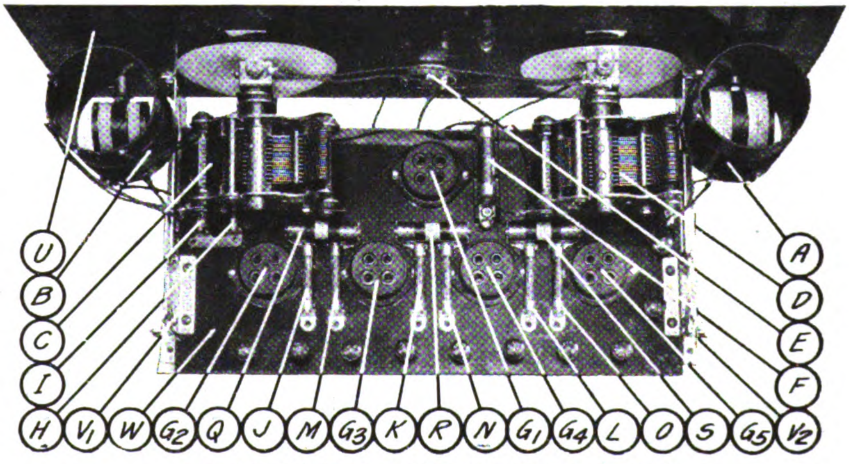
The first job will be to mount the brackets, V1 and V2, as shown in Figure 2. Drill two mounting holes for the brackets at each end of the panel, U. The holes are on center-lines 2¾ inches in from the sides of the panel. The lower hole is 15/32 inch above the bottom of the panel and the upper hole is 1¼ inches above the lower. Mount the brackets on the panel with the long flange down and turned outward.

Next mount the condensers, C and D, on the vernier dials and secure with the set screw which is provided. Figure 2 shows the correct positions for these units.

With the single-hole mounting fasten the antenna coupler, A, to the panel at the right end (looking from the rear of the set), with the main body of the coupler turned up above the rotor.

In the same manner fix the high-frequency transformer, B, in position at the left end of the panel. Then mount the rheostat, E, with the terminals up, in the center of the panel.

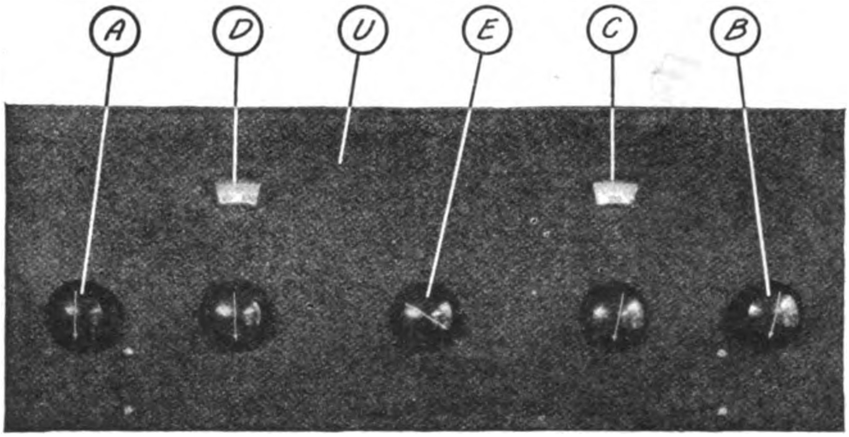
The remaining instruments are ready



A VIEW OF THE RECEIVER FROM ABOVE

FIGURE 2: *The valve sockets, together with the resistors and fixed condensers and their mountings, may be obtained already mounted in the Lynch five-valve Deluxe deck assembly; this makes the construction of the receiver a simple matter, even for the novice.*

The list of parts given on page 348 includes the exact instruments used in the set from which these specifications were made up. The experienced amateur, however, will be able to pick out other reliable makes of instruments which have been approved by Popular Radio *and which may be used with good results. But we recommend that the novice follow the list, as the diagrams in this article will tell him exactly where to bore the holes and exactly where to place the connections. If instruments other than the ones listed are used, the only change that will be necessary will be the use of different spacings for the holes that are drilled in the sub-base for mounting the instruments. To any reader who has difficulty in obtaining any of the parts which are necessary in making up these model receivers and power units,* Popular Radio Service Bureau, *119 West 57th Street, New York City, will gladly assist in seeing that his requirements are promptly supplied.*



THE FRONT PANEL OF THE RECEIVER

Figure 3: *The coupler, A, requires only one setting for all ordinary conditions of reception. Tuning is accomplished by means of the two knobs under the dial windows, C and D. At E is the filament switch, and at B is the control for regulating volume.*

mounted on the bakelite deck assembly, with the exception of the fixed condenser, P, and the grid suppressor, F. Mount the latter on the center line of socket G4, as shown in Figure 2. Condenser P will be held in position by the wiring to its terminals.

Mount the bakelite deck assembly underneath the bracket shelves, with the front edge 1 inch from the panel. It will be found necessary to place the antenna binding post over slightly to clear the bracket shelf.

With the antenna coupler and high-frequency transformer which are specified in the list of parts it will be found necessary to cut off the shafts slightly to make the tuning knobs set near the panel.

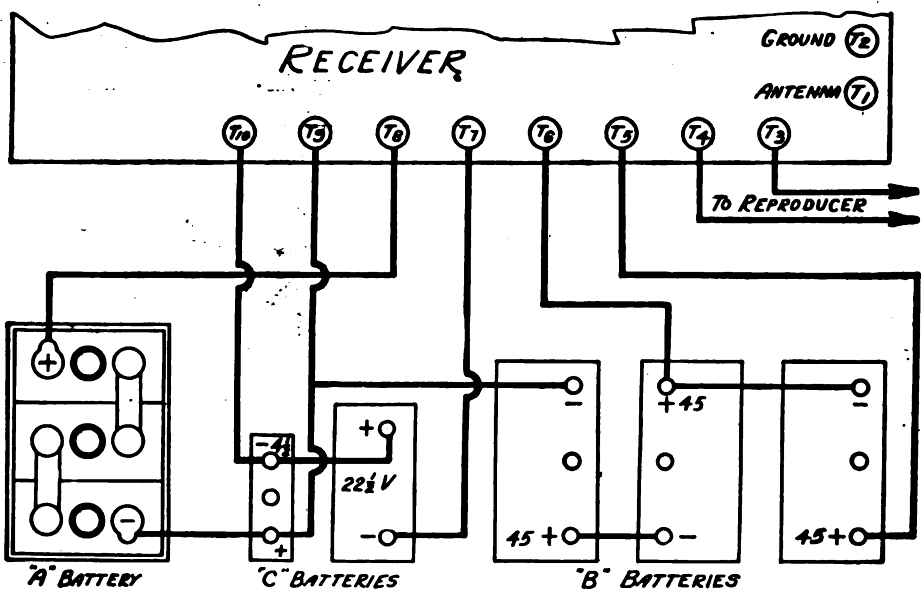
Wire the receiver according to the picture wiring diagram in Figure 1. A flexible wire with a braided insulation, which can be pushed back for making connections, such as Corwico, will be found to facilitate wiring. Much of the wiring is done under the panel.

How to Operate the Receiver

Now connect the batteries, the antenna, the ground and the loudspeaker according to the connection diagram in Figure 4. Insert a Ceco type K high-frequency amplifier valve in socket G1, a Ceco type H special detector valve in socket G2, two Ceco type G high-mu valves in sockets G3 and G4, and a Ceco type F power valve in socket G6. The receiver is now ready for use. First turn the rheostat, E, clockwise to light the valves. The rotor of the coupler, A, should be set for maximum coupling (with its axis coincident with the axis of the stationary coil). Some local station should now be tuned in by adjusting the two variable condensers, C and D, simultaneously. Finally the signal may be strengthened and cleared up by adjusting the volume control (the rotor of transformer B).

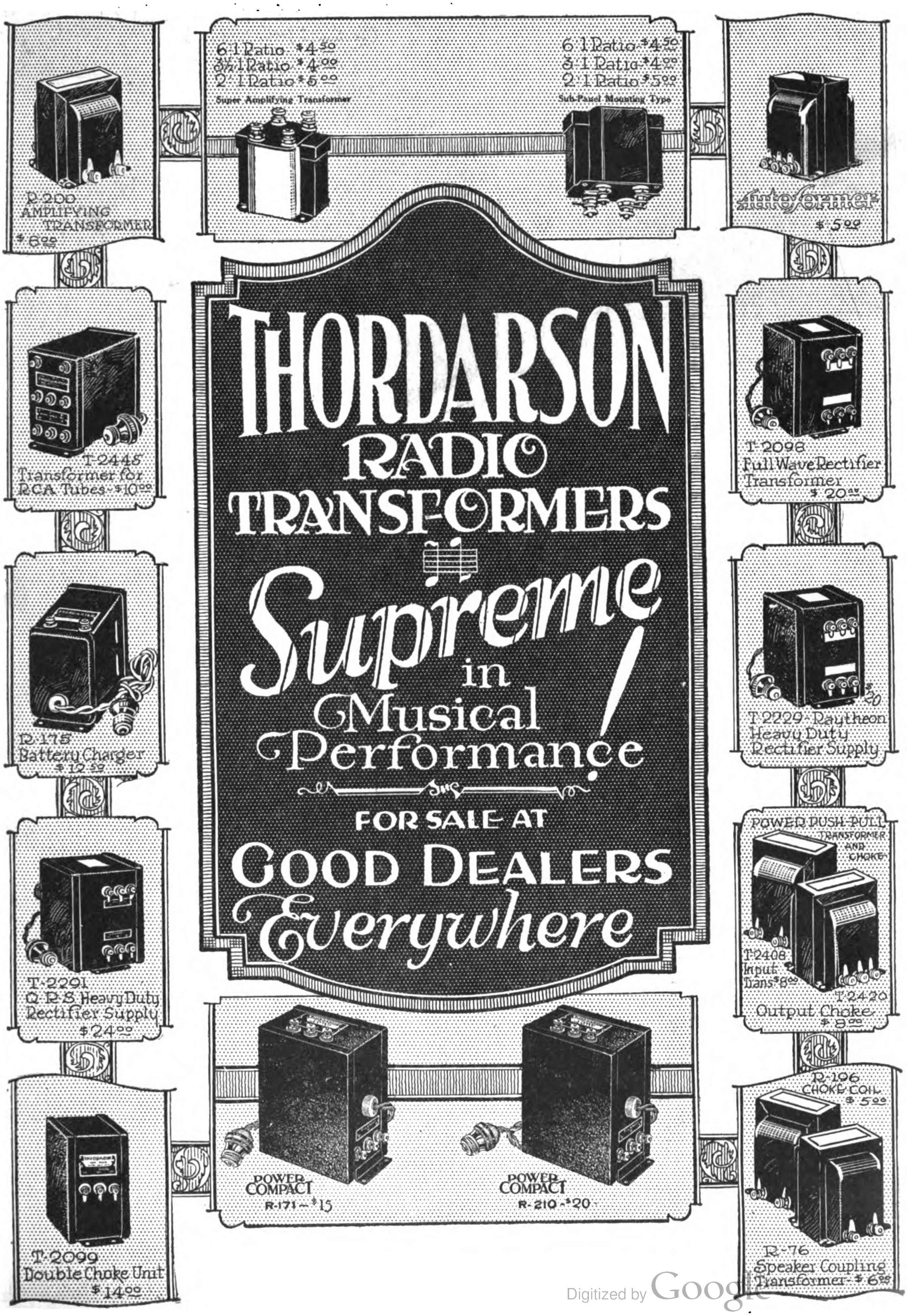
It will be found that the stage of high-frequency amplification will give good selectivity and sensitivity and the resistance-coupled amplifier will give a surprising quality of reproduction when used with a good loudspeaker.

The owner of such a set need never be ashamed of it, as it will have a realistic tone quality such as is found in receivers of many times its cost, and when housed in an attractive cabinet will take its place with the best home furniture in decorative effect.



HOW TO HOOK UP THE RECEIVER

Figure 4: *This diagram indicates the proper connections to be made between the row of binding posts on the receiver sub-panel and the batteries, reproducer, ground and antenna.*


R-200
AMPLIFYING
TRANSFORMER
$6.00
6-1 Ratio $4.50
3½-1 Ratio $4.00
2-1 Ratio $5.00
Super Amplifying Transformer
6-1 Ratio $4.50
3-1 Ratio $4.00
2-1 Ratio $5.00
Sub-Panel Mounting Type
Autoformer
$5.00
T-2445
Transformer for
RCA Tubes $10.00
T-2098
Full Wave Rectifier
Transformer
$20.00
THORDARSON
RADIO
TRANSFORMERS
Supreme
in
Musical
Performance!
FOR SALE AT
GOOD DEALERS
Everywhere
R-175
Battery Charger
$12.50
$20
T-2229 - Raytheon
Heavy Duty
Rectifier Supply
POWER PUSH-PULL
TRANSFORMER
AND
CHOKE
T-2408
Input
Trans $8.00
T-2420
Output Choke
$8.00
T-2291
Q.R.S. Heavy Duty
Rectifier Supply
$24.00
POWER COMPACT
R-171 - $15
POWER COMPACT
R-210 - $20
R-196
CHOKE COIL
$5.00
T-2099
Double Choke Unit
$14.00
R-76
Speaker Coupling
Transformer $6.00

You Will Marvel at the Tone Reproduction of the

TEMPLE AIR-COLUMN SPEAKER

People are positively astonished when they hear the TEMPLE AIR COLUMN SPEAKER for the first time. The marvelous clarity and purity of tone is amazing.

The TEMPLE AIR COLUMN SPEAKER brings new joy in radio. Thruout the entire musical scale this super-speaker is sensitive beyond comparison—unequalled for tone quality. Dance music—organ recitals—opera—hear them now in a way you never dreamed was possible!

Not a Cone

This new type speaker is selling like wildfire all over the country. New enthusiasts by the thousands are buying TEMPLE. Eddie and Fannie Cavanaugh, the Gaelic Twins of KYW, Chicago, say: "We have tried many speakers but none have the wonderful tone quality and volume of the TEMPLE."

Hear a TEMPLE AIR COLUMN SPEAKER demonstrated on the TEMPLE COMPARATOR at your nearest dealer. Make this test: Close your eyes as you hear different speakers. You'll pick the TEMPLE every time because of its unfailing purity and richness of tone reproduction.

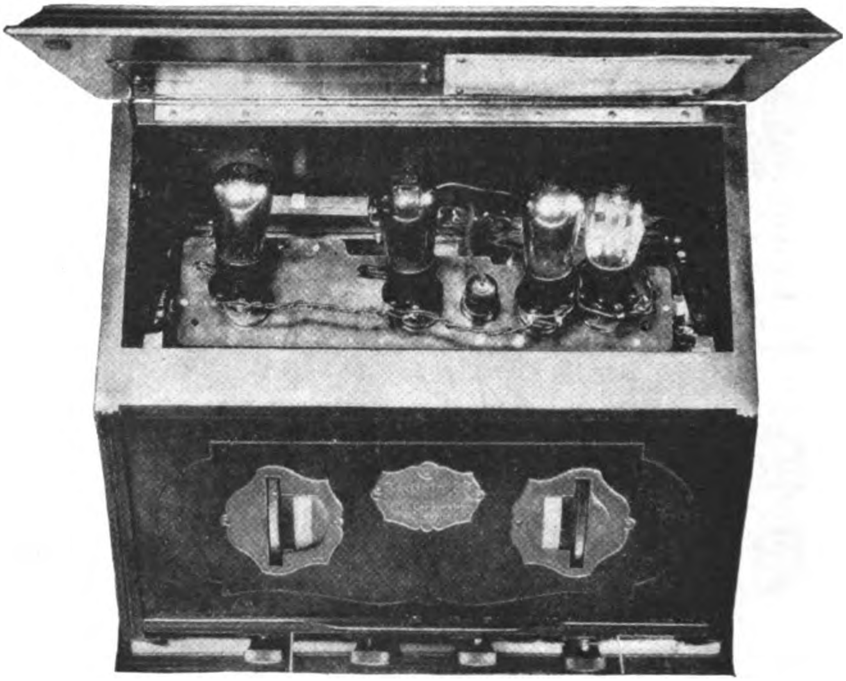
CONSOLE CABINET MODEL No. 65—priced at $65.00; west of Rockies, $75.00
DRUM TYPE MODEL No. 13—13 inch—priced at $29.00; west of Rockies, $32.00
DRUM TYPE MODEL No. 18—18 inch—priced at $48.50; west of Rockies, $55.00

If your dealer cannot supply you write for complete information and name of our nearest Temple dealer

TEMPLE, Inc.
213 S. Peoria St., Chicago, Ill.
LEADERS IN SPEAKER DESIGN

AC Rejuvenation for the Radiola 20

(*Continued from page 318*)



THE AC VALVES IN PLACE

Figure 3: *This top view of the receiver shows the four new valves in the adapter sockets with the plug from the Powerizer inserted in its socket. The general appearance of the receiver and the operation remain practically the same.*

may be placed in operation by throwing the switch of the power-pack. The AC valves will require about thirty seconds to heat up before they begin to operate, after which time the reception from the receiver should go on as smoothly as before the changes were made, but with added volume and improved tone quality.

The owner of a Radiola 20 desiring to make the changes outlined in this article should take care to see that his lighting current supplies AC current at a frequency of 60 cycles, since the Powerizer will not function on DC or on AC below the standard frequency.

The special sockets supplied as a part of the Powerizer equipment are provided with two exceptionally long prongs. These are the plate and grid prongs. The adapters are inserted in the sockets of the receiver in the usual way.

It will be noticed that there are no filament prongs in the adapters, since the filament current is supplied through a low voltage transformer contained within the Powerizer case. One transformer tap supplies 1½ volts for the UX-226 valve, and the other tap supplies 2½ volts for the UY-227 valve.

The filament leads from the transformer taps are carried directly to the filament terminals of the adapters. A rather large flexible connecting wire should be used. As a matter of fact, ordinary flexible lamp cord is well suited for this use.

The UY-227 valve is of the heater type and is used as a detector. Figure 2 shows the heater cathode in blue. It should also be noted that the old volume control is changed so that it will conform to the new circuit.

The operation of the receiver will remain substantially the same as it was before the installation of the Powerizer. Naturally, the tuning will not be affected. If UX-199 type valves were employed in the Radiola 20 previous to the attachment of the Powerizer, a considerable increase in volume and sensitivity will be noted.

The radio experimenter, the professional set-builder, and the radio dealers themselves will find in this change a chance to improve this type of set in many ways.

Tuned Low-Frequency Amplification Features

The Counterfonic Six

Kenneth Harkness' latest circuit employs a low-frequency amplifier in which each stage is tuned to cover a specific band of audible frequencies, with a resulting output of undistorted quality. Don't miss the advance information and constructional articles for this unique receiver, starting in the December number of Popular Radio.

Roxy's Absorbing Theory of "Radio Psychology"

(*Continued from page 313*)

icy of appealing to the sentimental side of human nature.

Probably one of the most interesting events for a man before the public is the advent of the daily mail. Here he finds the frank expressions of the opinions of the people, their likes and dislikes, their approval or disapproval, their response to him as an individual constantly in the public eye. Through the morning's mail which is deposited regularly on my desk I am often given a peep behind the scenes which proves invaluable in the daily task of pleasing the public. And the encouraging letters do a great deal to buck up my spirit on blue Mondays.

My motto is, "The public is always right" and to that end I read carefully the hundreds of letters from those who listen in and from the daily visitors who come to the Roxy Theatre, take their pens in hand to tell us how they feel about it all. When the criticism is constructive, I act upon it. If great admiration is expressed for an artist's talent, he is pushed forward. If a request is made, it is granted. After all, it's the public's broadcasting studio, built for their comfort and enjoyment. It's up to me to entertain them.

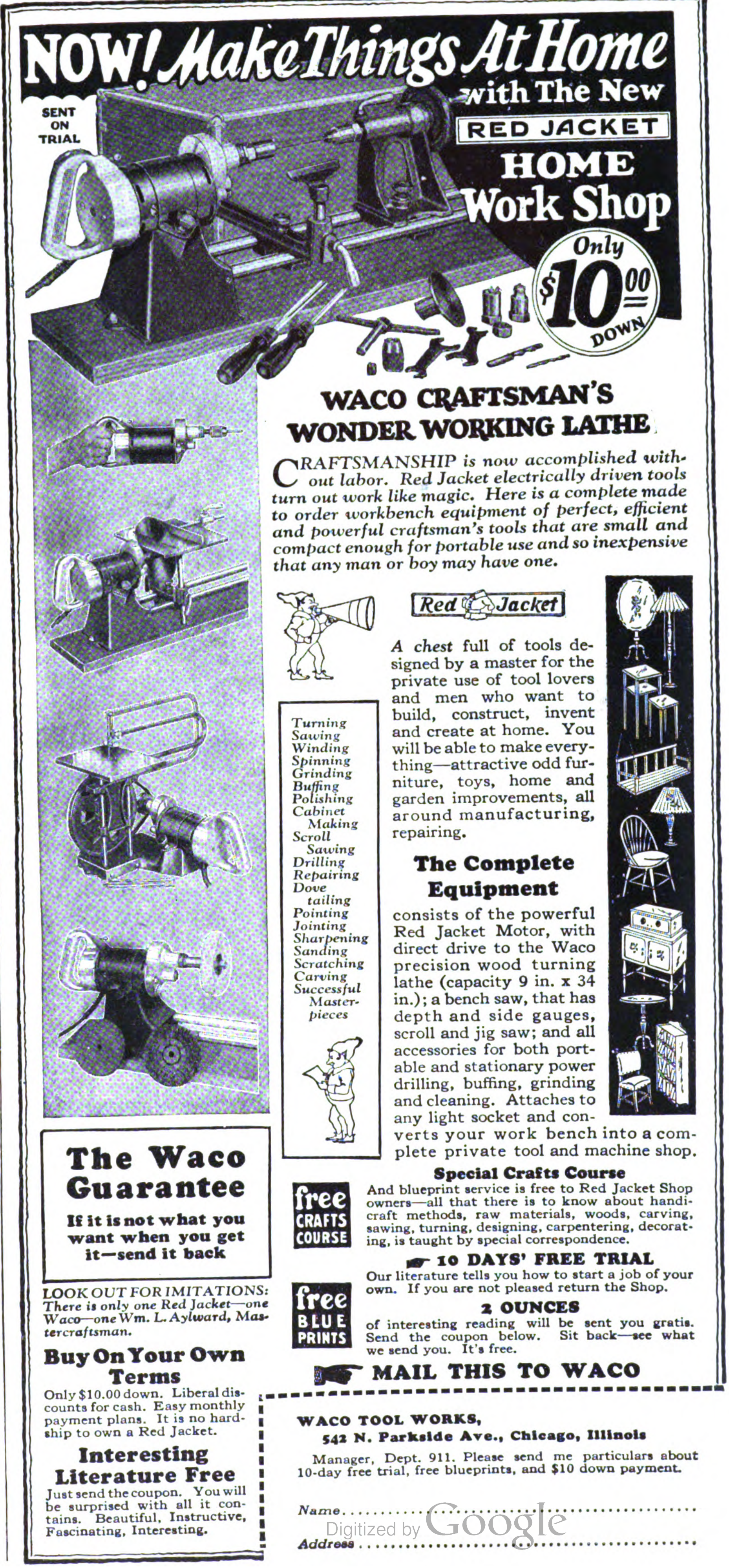
Forced and Free Vibrations

(*Continued from page 321*)

wholly to exclude them; but it is easy to exclude any ordinary station, even a nearby one, and listen to a distant station instead.

Regeneration thus judiciously applied to the N circuit may be small in amount, so that it may be left free and uncoupled to anything else. Melinsky's device of earthing the plate of the first tube gives the required stimulus in slight but sufficient amount, so that there is no loss of sensitiveness, in spite of the fact that re-radiation is avoided.

In most previous arrangements hitherto the antenna is usually attuned and coupled to a closed resonating circuit of the same frequency. In the new arrangement there is no tuned antenna and only slight coupling, in the ordinary sense; nor is there anything that can be called coupling for regeneration. The plan is to use a stiff circuit of high inertia, which can only respond to one particular frequency. It is left as free as possible to respond to that frequency, sufficient energy being introduced to overcome the damping, due to resistance, in a sufficient but slight manner and to avoid all feedback to the antenna, or any back communication to the ether, from the receiving station, so that it shall be a receiver and a receiver only—and not a spurious transmitter.



NOW! Make Things At Home with The New RED JACKET HOME Work Shop

SENT ON TRIAL

Only $10.00 DOWN

WACO CRAFTSMAN'S WONDER WORKING LATHE

CRAFTSMANSHIP is now accomplished without labor. Red Jacket electrically driven tools turn out work like magic. Here is a complete made to order workbench equipment of perfect, efficient and powerful craftsman's tools that are small and compact enough for portable use and so inexpensive that any man or boy may have one.

Red Jacket

Turning
Sawing
Winding
Spinning
Grinding
Buffing
Polishing
Cabinet Making
Scroll Sawing
Drilling
Repairing
Dove tailing
Pointing
Jointing
Sharpening
Sanding
Scratching
Carving
Successful Master-pieces

A chest full of tools designed by a master for the private use of tool lovers and men who want to build, construct, invent and create at home. You will be able to make everything—attractive odd furniture, toys, home and garden improvements, all around manufacturing, repairing.

The Complete Equipment

consists of the powerful Red Jacket Motor, with direct drive to the Waco precision wood turning lathe (capacity 9 in. x 34 in.); a bench saw, that has depth and side gauges, scroll and jig saw; and all accessories for both portable and stationary power drilling, buffing, grinding and cleaning. Attaches to any light socket and converts your work bench into a complete private tool and machine shop.

The Waco Guarantee

If it is not what you want when you get it—send it back

LOOK OUT FOR IMITATIONS: *There is only one Red Jacket—one Waco—one Wm. L. Aylward, Mastercraftsman.*

Buy On Your Own Terms

Only $10.00 down. Liberal discounts for cash. Easy monthly payment plans. It is no hardship to own a Red Jacket.

Interesting Literature Free

Just send the coupon. You will be surprised with all it contains. Beautiful, Instructive, Fascinating, Interesting.

free CRAFTS COURSE

Special Crafts Course

And blueprint service is free to Red Jacket Shop owners—all that there is to know about handicraft methods, raw materials, woods, carving, sawing, turning, designing, carpentering, decorating, is taught by special correspondence.

☛ 10 DAYS' FREE TRIAL

Our literature tells you how to start a job of your own. If you are not pleased return the Shop.

free BLUE PRINTS

2 OUNCES

of interesting reading will be sent you gratis. Send the coupon below. Sit back—see what we send you. It's free.

☛ MAIL THIS TO WACO

WACO TOOL WORKS,
542 N. Parkside Ave., Chicago, Illinois

Manager, Dept. 911. Please send me particulars about 10-day free trial, free blueprints, and $10 down payment.

Name..

Address..

NEW AERO CIRCUITS WORTH INVESTIGATING

The Improved Aero-Dyne 6 and the Aero 7 and Aero 4 are destined to be immensely popular this season!

AERO UNIVERSAL TUNED RADIO FREQUENCY KIT

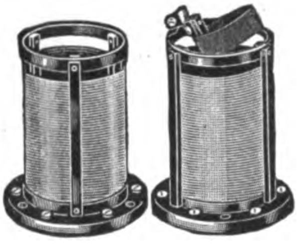
Especially designed for the Improved Aero-Dyne 6. Kit consists of 4 twice-matched units. Adaptable to 201-A, 199, 112, and the new 240 and A. C. Tubes. Tuning range below 200 to above 550 meters.
This kit will make any circuit better in selectivity, tone and range. Will eliminate losses and give the greatest receiving efficiency.

Code No. U-16 (for .0005 Cond.)....... $15.00
Code No. U-163 (for .00035 Cond.)..... $15.00

AERO SEVEN TUNED RADIO FREQUENCY KIT

Especially designed for the Aero 7. Kit consists of 8 twice-matched units. Coils are wound on Bakelite skeleton forms, assuring a 95% air dielectric. Tuning range from below 200 to above 550 meters. Adaptable to 201-A, 199, 112, and the new 240 and A. C. Tubes.

Code No. U-12 (for .0005 Cond.)...... $12.00
Code No. U-123 (for .00035 Cond.)..... $12.00



AERO FOUR KIT

An exceptionally efficient kit for use in the Aero 4 and other similar circuits. Consists of one Aero Universal Radio Frequency Transformer and one Aero Universal 3-Circuit Tuner. Uses 201-A, 112, 199 and new A. C. Tubes.

Code No. U-95 (for .0005 Cond.)....... $8.00
Code No. U-953 (for .00035 Cond.)..... $8.00

NOTE: *All AERO Universal Kits for use in tuned radio frequency circuits have packed in each coil with a "fixed primary" a twice matched calibration slip showing reading of each fixed primary coil at 250 meters and at 500 meters; all having an accurate and similar calibration.*

A NEW SERVICE

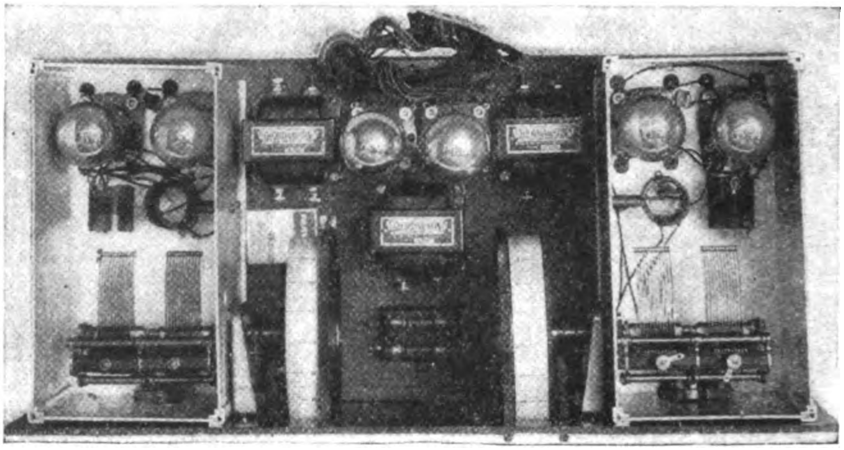
We have arranged to furnish the home set builder with complete Foundation Units for the above named Circuits and for the Chicago Daily News 4-Tube Receiver, drilled and engraved on Westinghouse Micarta. Detailed blueprints and wiring diagram for each circuit included in foundation units free. Write for information and prices.

You should be able to get any of the above Aero Coils and parts from your dealer. If he should be out of stock order direct from the factory.

AERO PRODUCTS, INC.
Dept. 104
1772 Wilson Ave., Chicago, Ill.

A Circuit New in Principle and Performance—The Octa-monic

(*Continued from page 329*)



THE RECEIVER AS SEEN FROM ABOVE

The tops of the shield cans have been removed, showing the high-frequency amplifier, divided in two parts, at the ends of the base panel, and the low-frequency amplifier in the center.

frequency wave (harmonic) generated in the valve is picked up to be delivered to the detector for rectification and passed on to the low-frequency amplifier.

A comparison of the relative selectivity of the Octa-monic and tuned-high-frequency systems should prove of interest. In Figure 1 is shown the standard circuit arrangement of a tuned-high-frequency receiver with three tuning circuits or stages. Directly beneath each grid and plate circuit are shown the various tuning curves as obtained in each part of the circuit.

The curve at 1 shows the curve in the tuned input circuit and that at 2 shows the resonant curve in the plate circuit of the first valve.

It will be noted that there is no gain in selectivity in this tuned stage, when the signal passes from the grid to plate circuit of the tube. The gain in the curve is merely one of amplitude or amplification, having the same rounded or broad tuning characteristic as the original curve in the grid circuit.

Curve 3 is made sharper by the second resonant circuit which tunes the input to the second high-frequency valve, while curve 4 shows a still greater increase in amplitude, but no increase of selectivity over curve 3.

Resonant curve 5 in the tuned input circuit of the detector valve is sharper because of the additional tuning stage in the detector circuit.

To effect the transformation or increase in selectivity represented by curve 5 over that represented by curve 1, two stages of tuned-high-frequency have been employed, using three tuned circuits and two amplifier valves.

In Figure 2 is shown the Octa-monic generator and detector circuits, with the resonance curves corresponding to each circuit. Resonance curve 6 in Figure 2 illustrates graphically the selectivity obtained in the tuned input of the harmonic generator. This, of course, is the same as that shown at 1 in Figure 1.

But when we look at the resonance curve for the plate circuit of this valve we find that curve 7, representing the curve form of the plate wave, is much sharper than the corresponding curve 2 of Figure 1. Careful measurement and plotting have shown that this curve 7 is equivalent in sharpness or selectivity to that shown as 3 in Figure 1.

Resonant curve 8 of Figure 2 is still sharper than curve 7, being made so by the tuned input to the detector, the detector input circuit being tuned to double the original signal frequency.

This resonance curve 8 is equivalent in selectivity to curve 5 of Figure 1, but this high degree of selectivity in the Octa-monic system shown in Figure 2 is accomplished with one less tuned circuit.

This remarkable increase in selectivity is but one of the features of this new circuit development. A further discussion of the principles which make this circuit an outstanding development in radio will appear in the next issue of POPULAR RADIO.

A Light Socket Superheterodyne

Here, at last, is what superheterodyne fans have been longing for for years—a super that gets its "A," "B" and "C" power from the lighting lines. Full constructional details in the December number of POPULAR RADIO.

The LC-28 Unipac Amplifier

(*Continued from page 326*)

battery cable that comes as part of the set. A 6-volt storage battery, preferably with a trickle charger, is used to light the valves of the LC-28 receiver. The Unipac requires no batteries.

Consult the hook-up diagram given in Figure 4 for the connections between the receiver and the Unipac. This shows a back view of the chassis of each of these units and indicates the cable connections and the proper colors of the wires to be connected. The plug of the Unipac should be inserted into a lighting socket with the switch turned "off." The antenna and ground are connected to the receiver in the usual way.

Place a UX-226 type AC valve or a CX-326 type AC valve in socket I. Place a UX-210 type AC or a CX-310 type AC power valve in socket H. Place a UX-874 or CX-374 type glow valve in socket G. Place two UX-216-b or CX-316-b type rectifier valves in sockets F1 and F2.

The unit is now ready for operation and the switch rheostat of the LC-28 receiver may be turned "on," as well as the switch of the socket of the house-lighting lines, and the set will be ready to operate, providing a reproducer has previously been connected to the two jacks O3 and O4. To handle the high-quality output of the LC-28 set satisfactorily, a reproducer of good quality should be employed.

There are no further adjustments to be made, either to the set or to the Unipac, and the complete receiver should be ready to give proper service for years to come without any trouble or tinkering.

A Measurement Chart

(*Continued from page 327*)

of 4 inches spaced 2 inches apart, considered from center to center of the coil windings. One coil has a self-inductance of 100 microhenrys and the other coil has an inductance of 210 microhenrys.

To use the chart first determine the ratio spacing divided by diameter

$$\frac{S}{D} \text{ which is } 2 \div 4 = .5.$$

Connect this ratio of displacement .5 on scale No. 1 with 100 microhenrys on scale No. 3.

Then, connect the intersecting point on reference line No. 4 with 210 microhenrys on scale No. 5 and carry the line over to scale No. 6, where it will pass through 24 microhenrys, which is the mutual inductance of the two coils.

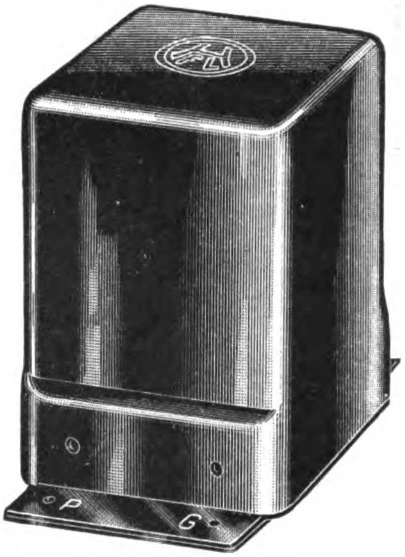
The effective inductances for the first circuit will then be 124 microhenrys and for the second circuit 234 microhenrys.

These values are within a fair degree of accuracy for engineering design work on radio circuits.

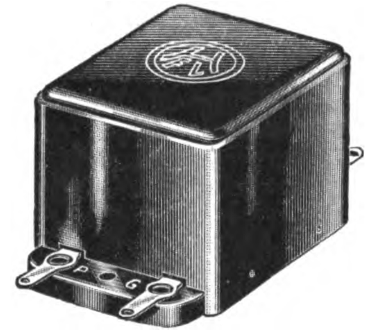
Transformers

Two Additions to Last Year's Radio Sensation. The Amazing Achievement in Audio Amplification

Designed for set builders who demand precision, sensitivity, high quality and efficiency



H. F. L. C-16 Audio Transformers and C-25 Output Transformer—New companions of a Great Unit, will work in any circuit and improve any radio set



H. F. L. Units Give Wonderful Clear Reception

Engineers acclaim H. F. L. C-16 a marvellously efficient Audio Transformer. It carries signals at highest volume and lowest amplitude without blasting or developing harmonics. Operates with all power tubes as well as standard tubes.

H. F. L. C-25 Output Transformer handles the voltage output of power amplifying tubes, at the same time matches the impedance of the average speaker to tubes. Protects loud speaker unit without reducing plate voltage.

Mechanical features of these two transformers are: A coil designed and treated to exclude moisture and withstand heavy electrical surges without breaking down—complete magnetic shielding to avoid inter-stage coupling—terminals brought out so as to insure short leads.

Set Builders—Dealers

If your jobber cannot supply you with H. F. L. Transformers, wire us for name of nearest jobber.

H. F. L. Facts

H. F. L. Units have been used, approved and most highly endorsed by *Radio News, Citizens' Call Book, Radio Review, Radio Age, Radio Engineering, Radio Mechanics, Chicago Evening Post*, the *Daily News* and others. Thousands of engineers and fans, who have turned to H. F. L. Units for better reception, hail them as the finest transformers known to Radio — unexcelled for Power, Selectivity and Purity of Tone.

Perfectly matched, skillfully designed, carefully made, rigidly tested—in a word, H. F. L. transformers are technically correct to the minutest detail.

All H. F. L. transformers are designed for baseboard mounting or invisible sub-panel wiring—each unit is enclosed and sealed in a genuine bakelite moulding.

H. F. L. Units are easily connected into the assembly, simplify set construction, and make a beautifully finished job.

Endorsed by America's Leading Engineers—Guaranteed by the Manufacturers

HIGH FREQUENCY LABORATORIES

133-F NORTH WELLS STREET, CHICAGO, ILL.

RADIO PROBLEMS SOLVED

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently; look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c a copy.

October, 1926
—How to Build the New LC-27 Receiver.
—The Radio Road Hog.
—POPULAR RADIO Circuits.
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-Pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

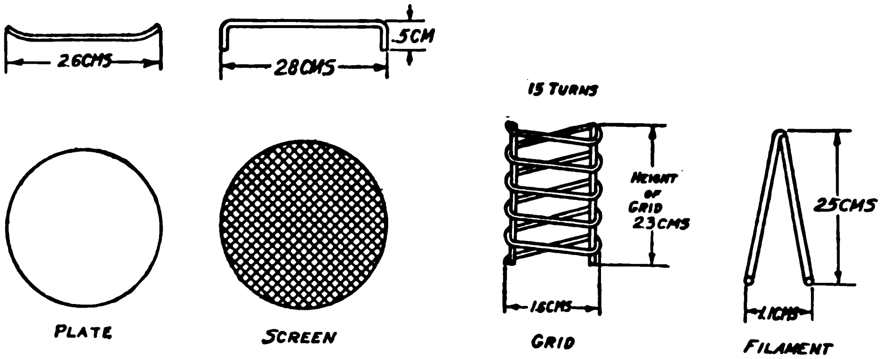
December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits
—How to Build the LC-Intermediate Power-Pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC Junior Power-Pack.

POPULAR RADIO
119 West 57th Street New York, N. Y.

The New High-Mu 2 Grid Valve

(*Continued from page 333*)



THE INNER ELEMENTS OF THE NEW VALVE

FIGURE 4: *At the left is shown the circular plate with its dimensions. At the center left is the general arrangement of the screen. At the center right is shown the spiral grid, while at the extreme right is the filament. These are placed one above the other in reverse order.*

densers and sometimes choking coils, according to the overall high-frequency amplification obtained.

The new valve is preferably mounted in a horizontal position, the grid and plate circuits being separated or isolated by metal screening boxes, so arranged that the partition dividing them is in the plane of the valve's screen grid, being cut away only just sufficiently to allow the glass bulb to pass through. The partition is earthed and the screen grid connected direct to the plate battery so that a practically complete electrostatic screen is formed.

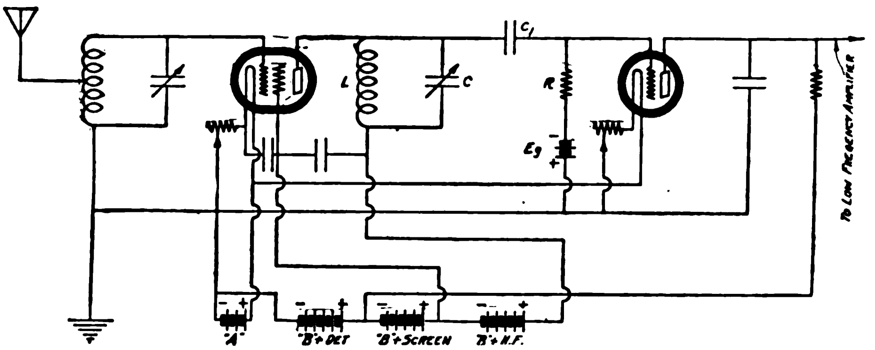
Sample valves have been tested, and two sets of characteristic curves that were obtained are shown in Figures 2 and 3. Figure 3 shows the plate current for various grid bias values for plate voltages of 120 and 140 with the screen connected to positive 78 volts. An additional curve on this diagram shows the screen current. By the usual methods the amplification factor was found to be 135 for a plate impedance of 300,000 ohms. These figures vary a good deal with plate voltage and grid bias, but those given are values which would be obtained under normal operating conditions.

Figure 2 shows how the plate current and screen current vary with plate voltage. The plate current rises rapidly with low plate voltages and then falls off, only to rise again and to remain practically steady for the higher plate voltages. The working part of the curve is the top portion, corresponding to plate voltages of 96 to 148. This top part is not quite flat and the two curves are roughly parallel. They show that the plate current can be changed by about 0.7 milliampere by one volt grid bias.

From these curves it is clear that the voltage amplification obtainable, given an output circuit of suitable design, is very large indeed; in fact, we can get from the valve a voltage variation of from about 196 to 148 volts. If the impedance of the plate circuit is very high, we can get this voltage variation with a small input. Thus if the impedance of the plate circuit were made identical with that of the valve we should obtain a voltage amplification of 67. We would therefore obtain an output voltage of 27 volts peak value from an input of 0.4 volt peak value.

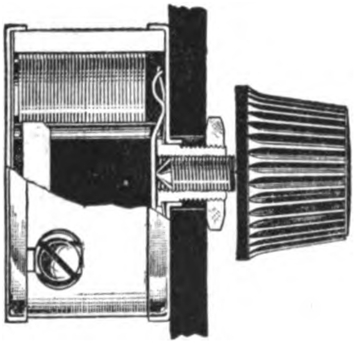
The valve is obviously one which will have to be used with circuits of high impedance, and ordinary high-frequency transformers will not be satisfactory.

A carefully constructed tuned plate circuit will provide the necessary im-



HOW THE SCREENED OR SHIELDED VALVE IS USED

FIGURE 5: *This schematic diagram shows the hook-up for one of the new valves employed as a high-frequency amplifier and connected to a regular detector circuit. The text of the article describes the constants for a simple receiver of this type that will give an amplification of 60 or better for the single stage.*



Bradleyohm-E
PERFECT VARIABLE RESISTOR

The graphite disc principle, utilized in the construction of Bradleyohm-E assures noiseless, stepless regulation of plate voltage when used in B-Eliminator hookups.

By turning the bakelite knob, the plate voltage output of the B-Eliminator can be adjusted, without steps or jumps, to the precise value for maximum volume. That is why prominent B-Eliminator manufacturers have adopted Bradleyohm-E.

Ask your dealer for Bradleyohm-E in the distinctive checkered carton.

Bradleyunit-A
PERFECT FIXED RESISTOR

This is a solid, molded fixed resistor that does not depend upon hermetic sealing for accuracy. It is not affected by temperature or moisture and can be soldered without disturbing its rating.

For resistance-coupling, grid leaks, and other applications, ask your dealer for Bradleyunit-A in any desired rating.

Allen-Bradley Co.
ELECTRIC CONTROLLING APPARATUS
276 Greenfield Ave. A-B Milwaukee, Wis.

BIG RADIO CATALOG

From the "Big, Friendly Radio House"

NEW 1928 Book offers finest, newest well-known sets; parts, eliminators, accessories at lowest prices.

Write for this Catalog!

Western Radio Manufacturing Company

136 West Lake St. Dept. 58
CHICAGO, ILL.

6 TUBE RADIO ONE DIAL *Only $32.50*

Latest advanced circuit. All-steel chassis, totally shielded. Balanced parts of best quality. Marvelous power and selectivity. Gets the long-range stations as clear as a bell. One-dial single control. Encased in cabinet of fine finish and rare beauty. Here is a value unsurpassed in the realm of radio—just one of the mighty bargains listed in my new catalog. Get full details before you buy any radio. An unsurpassed value — just one of our many mighty bargains.

FREE Catalog, Log and Call Book

It's just off the press! Chock-full of radio's latest and best 1928 developments. 132 pages of real radio information. Lists all the latest receivers, eliminators, chargers, speakers, kits, parts, etc. All the radio stations and newly assigned wave lengths. A regular encyclopedia of Radio information. And it's Free! Send for your copy today.

AMERICAN AUTO & RADIO MFG. CO.

Harry Schwartzberg, *Pres.*

Dept. 282 American Radio Bldg., Kansas City, Mo.

pedance, however, and is easily arranged. We have to remember, though, that a grid condenser and leak is necessary for coupling the stages. Thus a typical circuit will be as indicated in Figure 5. Here L is the tuning coil and C the tuning condenser of the first tuned plate circuit, C1 is the coupling condenser of .0003 mfd., while R is the grid-leak of 1 megohm. The return end of R is taken to the negative side of the filament battery so that the grid of the second valve has a negative bias equal to the fall in voltage over the filament rheostat. This is satisfactory, as the valve is a 5-volt one and would be heated from a 6-volt "A" battery.

For rectification, a valve set as a plate bend detector is used, the necessary grid bias being obtained through the grid battery, GB. To tune over the wavelength range of 200 to 600 meters, L may have an inductance of 290 microhenries and C a capacity of .0003 mfd. The impedance of this circuit at its resonant frequency is equal to

$$\frac{L}{CR}$$

ohms, ignoring the effect of the grid-leak. Thus the important factor is the resistance of the circuit, since for a given wavelength the inductance and capacity are fixed.

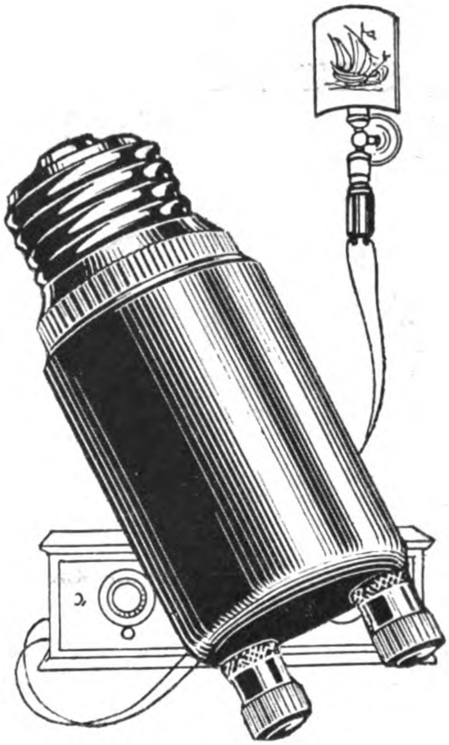
A circuit comprising a single layer coil, 3 inches in diameter, wound with No. 24 or 26 copper wire, will have an effective resistance of 80,000 to 100,000 ohms at 400 meters. Thus, with this coil we should obtain an amplification of about 34.

A better coil wound with 27 strands of No. 42 high-frequency cable will have a much lower resistance and the impedance of the circuit at 400 meters will be of the order of 250,000 ohms. The amplification with this circuit will therefore be 61 for the stage.

Measurements have been made for a single stage comprising a tuned plate circuit with a coil of high-frequency cable, and it was found that an amplification of well over 60 was obtained with perfect stability, with a simple screen placed between the grid and plate circuits. There was a certain amount of reaction which increased the signal a little, but did not cause instability at any wavelength. This was due to a slight coupling between plate and grid coils, but the tests serve to show that it is not necessary to employ complete screening when only one stage of high-frequency amplification is used.

It is quite a simple matter to build receivers with two or even three stages, but then the amplification is so great as not to make it worth while designing each stage for maximum amplification.

A single stage, designed as outlined in this article, should give enough amplification to meet the needs of any sort of reception.



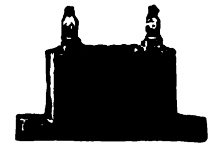
A Perfect Aerial in 5 Minutes

Just connect it to the set and plug in—that's all the work you need to do on an aerial that brings in programs with remarkable volume and clarity. It uses absolutely no current, reduces both static and interference, and completely eliminates the lightning hazard. Sold by all good dealers on a five-day, money-back basis for $1.50.

Dubilier
Light Socket Aerial

Building a Power-Unit?

Then select the condenser blocks built for long hours of heavy-duty service. Dubilier Blocks are the choice of leading manufacturers and of experimenters who build with care.



Micadon—the Standard of Radio

This famous fixed condenser is now incorporated in a moulded Bakelite case designed to meet modern receiver designs. Terminals adapted to soldered and screwed connections. All capacities. Price 45c to $1.50.

DUBILIER CONDENSER CORP.
4377 Bronx Blvd., New York City

Dubilier CONDENSERS

Employing the New R·G·S *"Octa-Monic" Principle*

BUILT FOR MODERN BROADCAST CONDITIONS

Not Regenerative! Not Tuned Radio

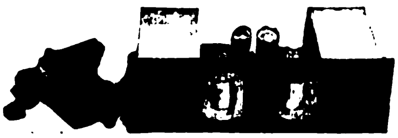
But the Radically and

R· G· S

A. C. Tube Models

R. G. S. "Octa-Monic"
A-C Tube Kit

including instructions and blue-prints; all necessary apparatus, ready to build, ***$119.60***



R. G. S. "Octa-Monic"
A-C Tube Chassis

Completely assembled according to latest laboratory methods, (carefully tested and selected heavy duty wire, lamp socket connections, cable, Power (A-C) Transformer, etc., etc.,) with instructions and blue-prints for installation, ready to plug in your lamp socket and operate, ***$129.60***

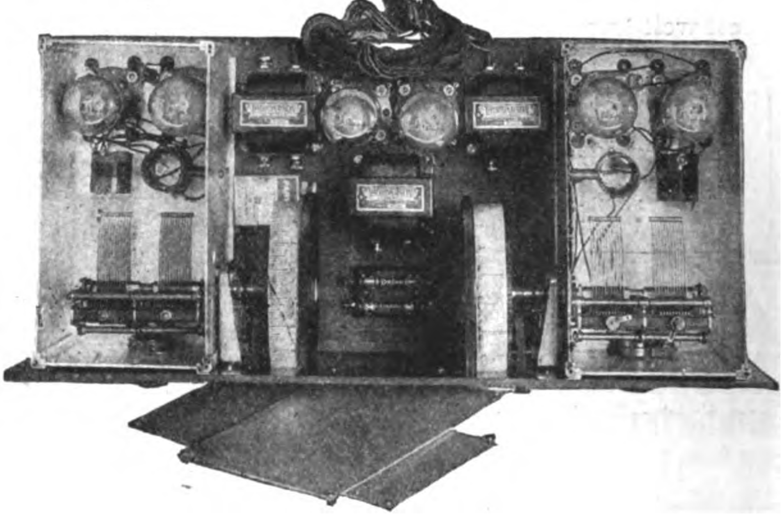
R. G. S. "Octa-Monic"
A-C Tube Receiver

housed in an attractive, partitioned, walnut table cabinet, ***$149.60***

NOTE: ***All models of the R. G. S. "Octa-Monic" have been adapted to the Cunningham A-C and Power Tubes, Four (4) CX 326, one (1) C 327, and one (1) CX 371. The "B" Battery Eliminator and the Cunningham Tubes are not included in the above prices. This eliminates an unnecessary expenditure on your part because the A-C Tube models of the R. G. S. "Octa-Monic" have been designed to operate satisfactorily with any good "B" Eliminator. It is recommended if your "B" Eliminator has no "C" battery tap, that you use the regular 40 volts of C battery.***

Price Notice

Above prices do not include Cunningham A-C and Power Tubes nor the "B" Battery Eliminator. All A-C models will operate on any good eliminator. This, therefore, permits the use of your own "B" Battery Eliminator, thereby representing a very distinct saving to you.



The fundamentally new R. G. S. "Octa-Monic" Receiver developed by David Grimes is one of the four great radio developments of the past 10 years. The R. G. S. "Octa-Monic" principles are fully as important and represent as basic a contribution to the Radio Art as did any of the discoveries of DeForest, Armstrong, Alexanderson, etc., etc.

These new and revolutionary principles of tuning, or the radio frequency end of the R. G. S. "Octa-Monic," produce results not only superior *but* these principles of tuning place this Receiver far in advance of any receiver developed to date. The R. G. S. "Octa-Monic" is fundamental and is as radically new as was the Super-Heterodyne.

These highly efficient principles employed in the new R. G. S. "Octa-Monic" cover not only the tuning or radio frequency end of this receiver but they cover the amplification end as well. The R. G. S. "Octa-Monic" amplifier (Power tube in the last stage) gives, unquestionably, as perfect reproduction as it is possible to buy, regardless of cost.

The R. G. S. "Octa-Monic" comes to you more heavily endorsed by able authorities than any other receiver ever presented to the Radio Public. The editor of one of the most important radio publications in America said that it was the only receiver he had ever seen in his career as an editor to which the terms "new and revolutionary" could be applied in good faith.

Selectivity superior to the super-heterodyne without cutting side bands, selectivity enough to eliminate the heterodyne squeals of local stations, operating on a higher octave; selectivity that is equal over the whole dial without being at all critical at any point; selectivity enough to separate with ease the local jumble of Metropolitan (New York City, Chicago, San Francisco, etc.) stations; selectivity enough to give five (5) degrees of silence between stations WEAF and WNYC in a location 200 yards away from WNYC.

Selectivity positive enough to make use of vernier control unnecessary.

Sensitivity or Distance-Getting Ability. Can work right down to static level. This insures trans-continental or trans-oceanic reception on favorable occasions.

Volume sufficient to fill a hall that will seat 3500.

Tonal Quality that is as nearly perfect as development in the Radio Art will permit.

Straight Line Audio Amplification.

Stability Margin of 800 ohms. The average receiver has a stability margin of from 6 to 20 ohms. This high stability margin of the R. G. S. "Octa-Monic" eliminates any possibilities of howling from poor batteries or "motor-boating" from eliminators. Batteries registering as low as 10 volts will deliver a clear tone, free from howling, in this receiver.

Straight Line Radio Amplification insuring reception at all broadcast wavelengths.

Straight Line Volume Control that makes distorting of tone impossible.

DEALERS: ***Write for Complete Merchandizing Proposals***

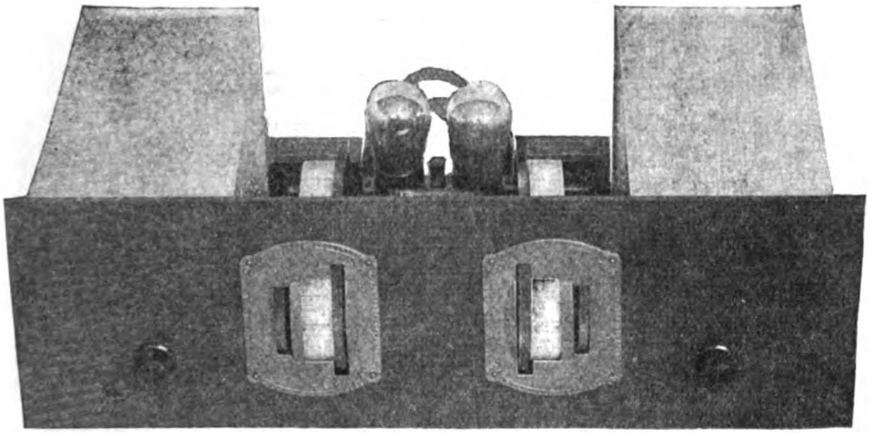
BUILT FOR MODERN BROADCAST CONDITIONS

Employing the New RGS *"Octa-Monic" Principle*

Frequency! Not a Super-Heterodyne!

Fundamentally New

"OCTA-MONIC"*



Automatic Wavetrap for prevention of heterodyning and whistling resulting from stations operating on one-half wave-length or on first octave beat.

Automatic Filament Control.

Employs 135 Volts or 180 Volts. Draws 22 mils.

Each R. G. S. "Octa-Monic" is carefully tested with scientific apparatus and under actual broadcasting conditions before it leaves the laboratories; while every piece of apparatus is just as thoroughly tested before it is built into this receiver.

The R. G. S. "Octa-Monic" is a closely co-ordinated Receiver built of quality apparatus. Careful tests are the basis for the choice of each piece of apparatus, tests that not only determine the merits of each individual part, but more importantly its relation to the whole receiver.

Standard Cunningham tubes (5, CX301-A's and 1, CX371, Power tube in last stage) and Western Electric Cone are recommended for best results.

The R. G. S. "Octa-Monic" is highly attractive in appearance. It is built on five-ply, specially shellacked sub-panel (20" x 9") to which is mounted a beautiful walnut finished, standard size panel (7" x 21") that will fit any good cabinet or fine console 7" x 21". The panel and drum escutcheons are trimmed in dull bronze.

You will find your R. G. S. "Octa-Monic" mighty easy to operate.

There are but two drums with vernier adjustments and two control knobs, one of which is an ordinary volume control and filament switch, the nearest approach to tuning efficiency, **possible.** Stations actually "click" or "tumble in" as you slowly revolve your drums.

The customary need of wooden screw-drivers or involved balancing devices is entirely removed in the R. G. S. "Octa-Monic." Major or minor adjustments are unnecessary. The R. G. S. "Octa-Monic" is free from ordinary service. Tuning condensers are the only moving parts, and as a consequence, there are no fussy mechanisms, either mechanical or electrical, to get out of order.

The R. G. S. "Octa-Monic" operates satisfactorily on either a good "B" battery eliminator or batteries without "motor-boating" or howling.

Orders cannot be accepted for individual pieces of apparatus or blueprints.

The R. G. S. "Four" employing the Inverse Duplex System (1) R. G. S. "Four Kit, all parts, complete instructions, $74.40. (2) Chassis, assembled according to latest laboratory methods, $84.40.

All prices slightly higher west of Denver. Canadian and Export prices on request.

Go to your dealer to-day and insist on a demonstration. If he hasn't stocked the R. G. S. "Octa-Monic" yet, tear off and mail to us the attached coupon with the required information. Every effort will be made to arrange a demonstration for you.

Arrange for that demonstration now because you have a real radio thrill waiting for you. In the R. G. S. "Octa-Monic" you will hear radio at its best. And when you hear the R. G. S. "Octa-Monic" you will know why it is: ***"The Synonym of Performance."***

All models of the R. G. S. "Octa-Monic" and the R. G. S. "Four" are fully protected by Grimes Patents issued and pending.

**Trade Mark Registered.*

DEALERS: ***Write for Complete Merchandizing Proposals***

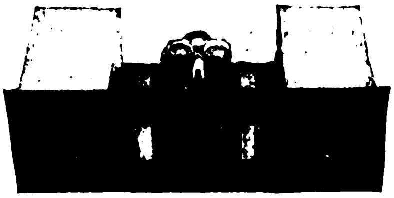
R-G-S Manfg. Co., Inc.

Staten Island **New York**

Battery or "B" Eliminator Models

R. G. S. "Octa-Monic" Kit

of parts including all required apparatus, complete instructions and blue-prints, ready to build, ***$84.60.***



R. G. S. "Octa-Monic" Chassis

completely assembled according to latest laboratory methods, (closely co-ordinated and specially designed apparatus, eight foot Da Hery cable, etc., etc.) with complete operational instructions, ready to operate, ***$89.60.***

R. G. S. "Octa-Monic" Receiver

housed in an attractive, well-designed, walnut table cabinet, ***$104.60.***

R. G. S. "Octa-Monic" Tuning Kit

including all necessary apparatus and complete blue-prints and instructions, ***$63.60***

R. G. S. "Octa-Monic" Tuning Chassis

completely assembled according to latest laboratory methods with complete instructions and ready to wire to your favorite amplifier, ***$66.60***

Price Note

The apparatus required to build the radically new and fundamental R. G. S. Octa-Monic actually lists at over $100.00.

R. G. S. MANFG. CO., Inc.
Staten Island, New York

Gentlemen:

Please arrange with my dealer, whose address I have printed below, for a demonstration of the new and revolutionary R. G. S. "Octa-Monic." I am much interested in this receiver but this request for a demonstration and literature, you understand, entails no obligation on my part.

My Name..

Street..

City or State...

My Dealer's Name.................................

His Address...

BUILT FOR MODERN BROADCAST CONDITIONS

Kept Cool!

Like the best Airplane Motors

TRUVOLT

An All-Wire Variable Voltage Control

Here is the finest voltage control you can possibly buy for your power devices! Its special mechanical construction gives greater radiation area and keeps it cool like an air-cooled engine. This prevents deterioration and assures permanent accuracy with long life.

Resistance made entirely of nichcrome wire with very low temperature coefficient and exposed directly to air—heat not held in by enamel coverings as in other resistances. Permits potentiometer control and gives positive metallic contact at all times with 30 exact readings of resistance.

Type	Ohms Resistance	Milliamperes Current
T-5	0 to 500	224
T-10	0 to 1,000	158
T-20	0 to 2,000	112
T-50	0 to 5,000	71
T-100	0 to 10,000	50
T-200	0 to 20,000	35
T-250	0 to 25,000	32
T-500	0 to 50,000	22.5

Eight stock types with resistances up to 50,000 ohms. All rated at 25 watts.

Price, $3.50 each.

Also full line of fixed wire resistances.

Write for free hook-up circular.

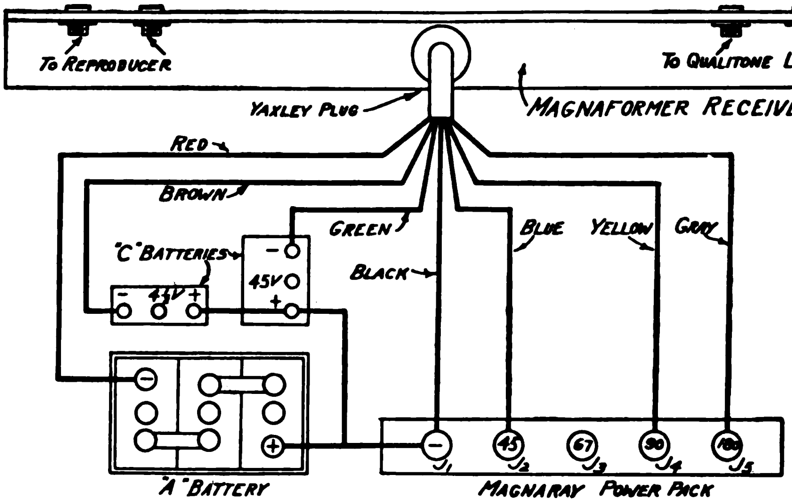
"This Is An Eliminator Year"

Dept. 18A, 175 Varick Street,
New York, N. Y.

ELECTRAD

The MagnaRay Power-Pack

(*Continued from page* 331)



HOW TO HOOK UP THE MAGNARAY

FIGURE 3: *The connections to be made between the Magnaformer, the MagnaRay and the "A" and "C" batteries are clearly shown in this diagram. The Yaxley plug and cable come with the Magnaformer receiver.*

has been mounted. Wires should be connected up from binding posts J1, J2, J3, J4 and J5 to the cable furnished with the Magnaformer. The connections should be made as shown in Figure 3. A storage battery may be used as indicated in the diagram. Preferably a unit equipped with a trickle charger such as the Westinghouse, the World Storage Battery Co. unit, or the Fansteel "A" Power, may be used.

A Raytheon BH rectifier valve should be used in socket D and a Raytheon R regulator valve should be placed in socket E, with the proper connection made to its shell for the starting electrode.

When the complete unit has been hooked up with the Magnaformer receiver, and the loudspeaker and Quali-Tone loop have been connected, the switch on the receiver should be turned to the "on" position. The plug on the cable connected to the power transformer, A, of the MagnaRay power-pack should be inserted in the socket and the house lighting current turned "on."

The receiver is now ready for operation and the voltages applied will remain perfectly constant irrespective of the lighting voltage variation in the house-lighting lines.

The regular operation of the Magnaformer 9-8 receiver may be carried out in exactly the same manner, from this point on, as described in the October issue of POPULAR RADIO, in the article on the construction and operation of the Magnaformer.

The complete unit will, from this time on, be automatic in operation and need no further adjustment or attention outside of filling the "A" battery with distilled water as it becomes necessary. This may be done at intervals of about four months.

The MagnaRay Power-Pack will maintain, at all times, efficient operation of the set, and enable the user to get the highest amount of satisfaction with the least worry and bother.

The Phono-Radio Reproducer

(*Continued from page* 336)

of the way "in") so that any of the local stations may be tuned in by the main control knob without resorting to the use of the correction adjustment each time.

On the panel of the power-pack amplifier will be found both a detector and a high-frequency amplifier "B" voltage adjustment device. Both of these levers should be moved until the best setting is found. With a receiver of the type described in this article, the optimum detector adjustment will most likely be at the center of the available voltage range, while the optimum high-frequency "B" voltage adjustment will most likely be the minimum voltage obtainable.

The "B" negative and "A" negative terminals on the amplifier should be connected together as shown in Figure 2.

In order to secure the full value of the excellent reproduction possible from a receiver employing a combination low-frequency amplifier and power-pack, such as the National, it is most essential that a high-grade reproducer be employed. The exponential horn type or the better grade of cone type, or a panel type such as the Lata balsa wood, are all satisfactory.

Want More Money?

You Can Increase Your Earning Power By Learning More About Radio

If you're making a penny less than $50 a week, you're not getting what you ought to get out of Radio.

Thoroughly trained men—men whose knowledge of Radio is completely rounded out on every point—earn all the way up to $250 a week.

Radio is a new industry with plenty of fine positions unfilled. There are countless opportunities in Radio for a man to earn a splendid salary. But these are not opportunities as far as you are concerned, unless you're fully qualified for them.

The only way to qualify is through knowledge — training — *practical, complete* training, that fits you to get and to hold a better position in the Radio field.

See If This Free Book Can Do You Any Good

I publish a 64-page book, printed in two colors and filled with facts and photos relative to Radio and its opportunities.

I don't say this book will help you, but it *does help* such a large percentage of those who read it that I can afford to send it to all who ask for it—free. You may get only a single idea out of this book that will be of any value to you. Or every line of it may give you a message.

At any rate, fill in the coupon below and look it over. It costs you nothing but a two-cent stamp, and you place yourself under no obligation. I won't even send a salesman to call on you. And there's always a chance that that two-cent stamp may make quite a difference in your future.

A message to men now in the Radio business. And another to men who would like to be in.

I have helped all sorts of men to advance themselves in Radio. Lots of them, men who knew absolutely nothing about Radio when they first wrote me. Some who didn't know the difference between an ampere and a battle axe.

Others, graduate electrical engineers who wanted special work in Radio. Licensed sea operators who were way behind on the "BCL stuff." "Hams" by the score.

Last, but not least, the service and repairman or salesman who wanted to advance or go into the Radio business on his own. And the man already in on his own, who wanted to look forward to a more solid and permanent Radio future.

My Free Book—see coupon below—tells about my helpful methods, and cites the experiences of a hundred men—giving photos and addresses.

What My Radio Training Is

Under my practical system, a man can study at home in his spare minutes and get a thorough, clear, practical and expert knowledge of Radio in from 4 to 12 months. The time required depends on his previous knowledge, his ability, and the time he can spare for study. He keeps right on with the job he has—no necessity for his leaving home or living on expense.

Then, as soon as he's ready for a better position, I'll help him to get it and to make a success of his work.

This proposition is open to anybody who is not satisfied with his job, his prospects, or his Radio knowledge. Regardless of how much you know already (or if you don't know the first thing about Radio technically), I'll fit my methods to suit your needs.

If you want to enter into any correspondence about your own situation, anything you write will come directly to me and will be held strictly confidential.

Tear the coupon off now before you turn the page and mail it to-day.

J. E. Smith, President

National Radio Institute

Oldest and Largest
Radio Home-Study
School in the World

Washington, D. C.

Originators of
Radio Home-Study
Training

J. E. Smith, President,
National Radio Institute,
Department 0-86, Washington, D. C.

Please send me your free book about the bigger opportunities awaiting the thoroughly trained Radio man. At present I (am) (am not) in the Radio business.

Name..

Address..

Town.......................................State.......................................

ACME
Celatsite
Battery Cable

A rayon-covered cable of 5, 6, 7, 8 or 9 vari-colored Flexible Celatsite wires for connecting batteries or eliminator to set. Plainly tabbed; easy to connect. Gives set an orderly appearance.

Stranded Enameled Antenna

Best outdoor antenna you can buy. Seven strands of enameled copper wire. Presents maximum surface for reception, resists corrosion; this greatly improves the signal. Outside diameters equal to sizes 14 and 16. (We also offer solid and stranded bare, and stranded tinned antenna.)

Loop Antenna Wire

Sixty strands of No. 38 bare copper wire for flexibility, 5 strands of No. 36 phosphor bronze to prevent stretching. Green or brown silk covering; best loop wire possible to make.

Flexible Celatsite for sub-panel wiring

A cable of fine, tinned copper wires with non-inflammable Celatsite insulation. Ideal for sub-panel or point-to-point wiring. Strips easily, solders readily. Nine beautiful colors; *sold only in 25 ft. coils, in cartons colored to match contents.*

Acme Celatsite Wire

Tinned copper bus bar hook-up wire with non-inflammable Celatsite insulation, in 9 beautiful colors. Strips easily, solders readily, won't crack at bends. Sizes 14, 16, 18, 19; 30 inch lengths.

Spaghetti Tubing

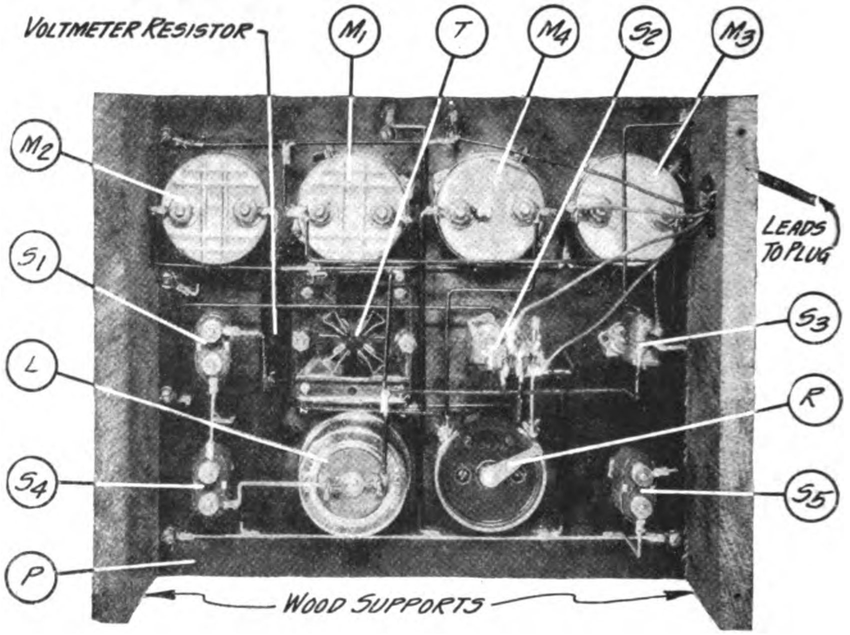
Oil, moisture, acid proof; highly dielectric — used by leading engineers. Nine colors, for wire sizes 12 to 18; 30 inch lengths. (We also make tinned bus bar, round and square, in 2 and 2½ ft. lengths.)

Send for folder
THE ACME WIRE CO., Dept. P
New Haven, Conn.

ACME WIRE
MAKES BETTER RADIO

How to Build and Operate the Universal Tester

(*Continued from page 346*)



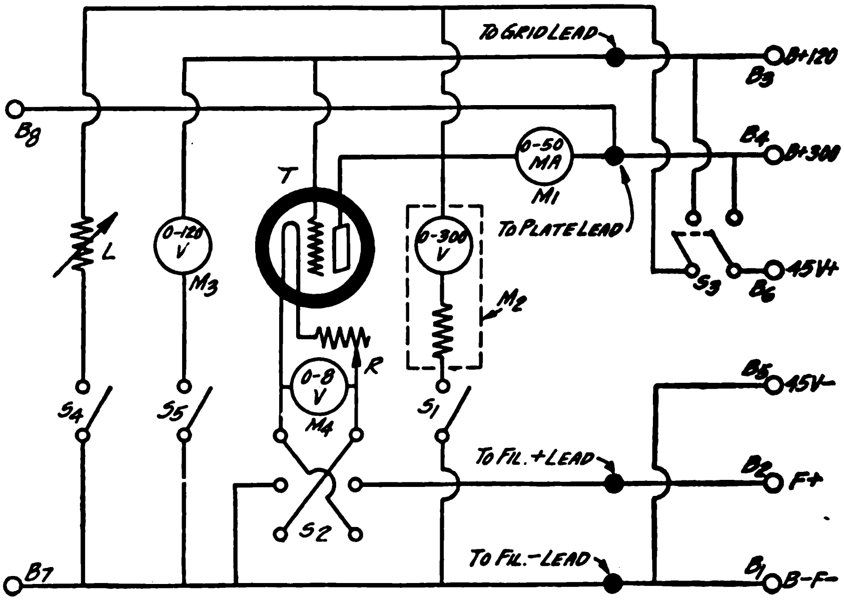
THE UNDER SIDE OF THE TESTER PANEL

FIGURE 2: *The layout of the meters and other instruments is clearly shown in this view. The wood blocks to support the panel should be cut to fit the particular case that the constructor wishes to use.*

On page 346 is shown the set built by the author and installed in a small leather carrying case. Figure 3 gives schematically the circuit employed.

All the instruments are mounted on a composition panel, drilled according to the specifications given in Figure 5. After the instruments are mounted, as shown in Figures 1 and 2, the wiring may proceed. This should be done as shown in the picture wiring diagram in Figure 1. The mounting and wiring of the instruments is so clearly shown in these illustrations that it is unnecessary to describe it step by step.

The testing plug may be made from the base of a burnt-out UX type of valve; the glass in the valve and other matter may be removed from the plug by carefully warming it until the cement matter is melted out. The ends of the cords to be terminated in the plug may now be inserted. It is very important that these cords should be spaced apart from each other as far as possible. The capacity effect between plate and grid leads may be sufficient to cause a variation in readings in plate current; therefore, wide separation of these leads is imperative. Of course, care



THE SCHEMATIC CIRCUIT OF THE TESTER

FIGURE 3: *The heavy black dots indicate the point where the leads to the tester plug are connected. Switch S2 is used to correct the polarity of a receiver under test to coincide with the polarity of the voltmeter.*

HOW TO OPERATE

The Universal Tester and Trouble Shooter

1. FOR VALVE RATING. Connect the "A" battery to the negative (—) and Fil. positive (+) posts. Insert the valve to be tested in the tester socket. Put switches 2, 3 and 5 to "on" position. Adjust the rheostat to proper voltage. Press button on milliammeter and read filament emission.*
2. FOR VALVE CIRCUIT TESTS. Remove the vacuum valve from its socket in the receiver under test and insert plug. Insert the valve in the tester socket. Read filament voltage with switch 2. The rheostat must be out. Press the button on the milliammeter to read plate current.
3. FOR POWER-PACK OUTPUT TESTS. Connect the output of the power-pack to the binding post marked "Elim." Turn "on" switches 1 and 4 and press button on the milliammeter. By adjusting the knob marked "Load," voltages at various current loads may be measured.
4. FOR BATTERY VOLTAGE TESTS. For voltages up to 300, connect the source of voltage to the binding posts marked negative (—) and "B" 300. Pull switch 1 and read the voltage. For voltages up to 120 volts, connect source of voltage to binding posts marked negative (—) and "B" 120. Pull switch 5 and read voltage. For voltages up to 8 volts, connect the source of voltage to binding posts marked negative (—) and Fil. positive (+). Turn switch 2 to the left and read the voltage.
5. FOR OPEN-CIRCUIT TESTS. Place the coil or transformer to be tested in series with one side of the 45-volt "B" battery. Turn switches 5 and 3 "on." A closed circuit shows a reading on the 120-volt meter; an open circuit does not. A good condenser shows a "kick" of the needle of the voltmeter; a shorted condenser shows a steady reading of the voltmeter.
6. FOR USING MILLIAMMETER SEPARATELY. Connect the positive terminal of the current source to the "B" 300-volt binding post, and the negative (—) terminal to the "B" 120-volt binding post. Turn switch 3 "on" and press the button on the milliammeter for the current reading.

NOTES

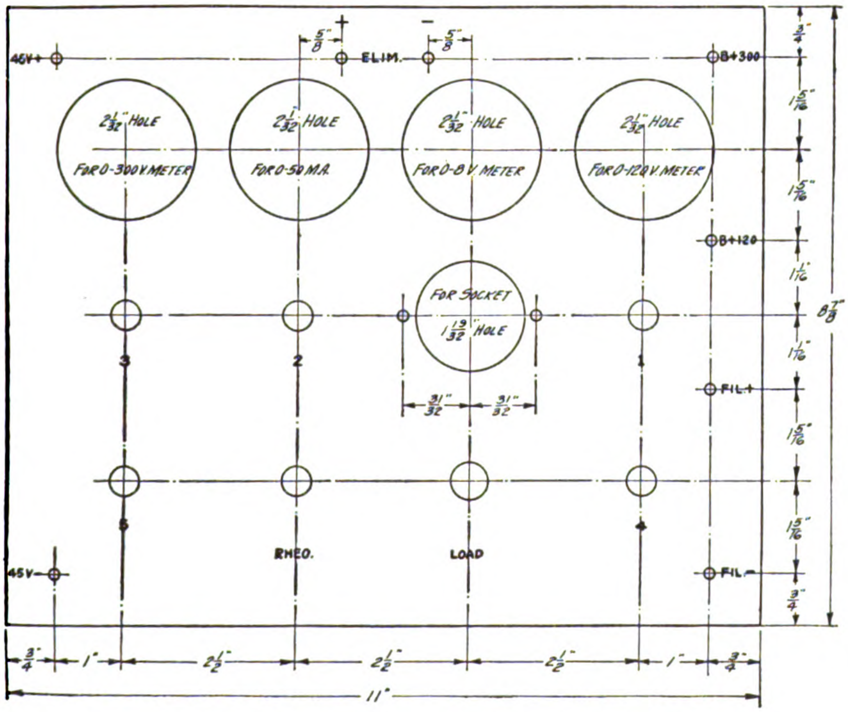
A. Switch 2 is a double-pole, double-throw filament switch which is turned by the operator to correct the polarity of the receiver to coincide with the voltmeter.

B. For test Nos. 1 and 5, the 45-volt battery must be in the circuit and connected to the binding posts marked "45 V" and "45 V—."

C.* UX-201-a type valves, at 5 volts filament, should have over 25 milliamperes emission; UX-199 type valves, at 3.3 volts, over 6 milliamperes; UX-120 type valves, at 3.3 volts, over 15 milliamperes; UX-200-a type valves, at 5 volts, over 12 milliamperes; UX-171 type valves, at 5 volts, over 50 milliamperes.

PASTE THIS TABLE ON THE COVER OF YOUR TESTER

FIGURE 4: *This table contains complete, condensed data for the operation of the Universal Tester, and should be kept handy for use. The ingenious experimenter will find many other uses about the laboratory or service shop to which the tester may be adapted.*

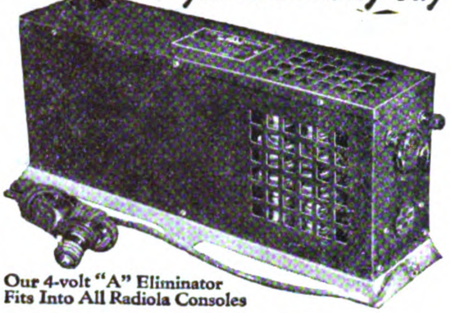


HOW TO DRILL THE PANEL OF THE TESTER

FIGURE 5: *The exact positions of the instruments and the sizes of the holes are clearly indicated in this diagram. The meters are equipped with mounting rings that fasten them to the panel by means of small screws that come with the meters. No other fastening is required for them.*

Finally—the Perfect "A" Eliminator

For Your Present Set or the Set you eventually buy



Our 4-volt "A" Eliminator Fits Into All Radiola Consoles

Silver A Beauty POWER

Replaces "A" storage battery and charger; has full wave "dry" rectification; maintains required voltage in uniform, constant flow; operates automatically by moving a switch; economical—uses minimum amount of current (about 1-10 cost of using electric iron); has rheostat control for additional refinement in voltage and reception; gives maximum power to radio tubes and lengthens their life; no acids to test or spill. Satisfactory results guaranteed.

Its principle is simple and correct!

The 110 volts Alternating Current is scientifically reduced with the famous *"Silver Beauty"* transformer coil to deliver the proper voltage to an *especially developed dry, noiseless rectifier,* which transforms the electricity to direct current. This current of exact voltage, is then transmitted through a patented special filter which clarifies the current, eliminating all foreign noises caused by rectifier or generator.

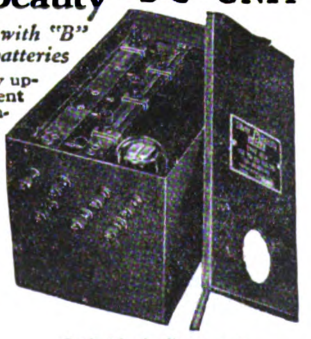
The *Silver Beauty* "A" Eliminator is endorsed by prominent radio engineers—adopted by leading distributors and dealers—approved by thousands of users. These are sufficient reasons for making *Silver Beauty* your choice.

$39.50	$43.50	$39.50
6-volt; 2 amp.	6-volt; 3 amp.	4-volt; ½-amp.

$2 Higher West of Rockies

Silver Beauty "B-C" UNIT

Does away with "B" and "C" batteries



Embodies every up-to-date refinement and principle, insuring smooth, unfailing reception. As beautiful as it is efficient.

No. 450
180 Volts—40 Milliamperes
$45

No. 460
135 Volts
$35

Individual adjustment adapted to all sets.

RADIO MANUFACTURERS' ASSOCIATION RMA MEMBER

Silver Beauty CHARGERS

Employing an entirely new method of rectification. Two models —with or without bulbs.

See Your Dealer or Jobber

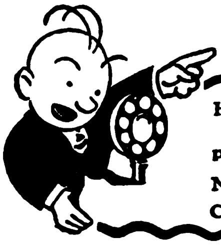
Triple-A-Specialty Company
Manufacturers of the famous Silver Beauty Chargers
312-316 South Hamilton Ave., Chicago, Ill.

Radio Parts and Accessories
—at Astonishing Prices!

Dealers, set-builders and fans by the hundreds are ordering this merchandise of the world's best-known manufacturers. Its quality is the best, and our prices will surprise you. In fact, you have a treat in store when you see this

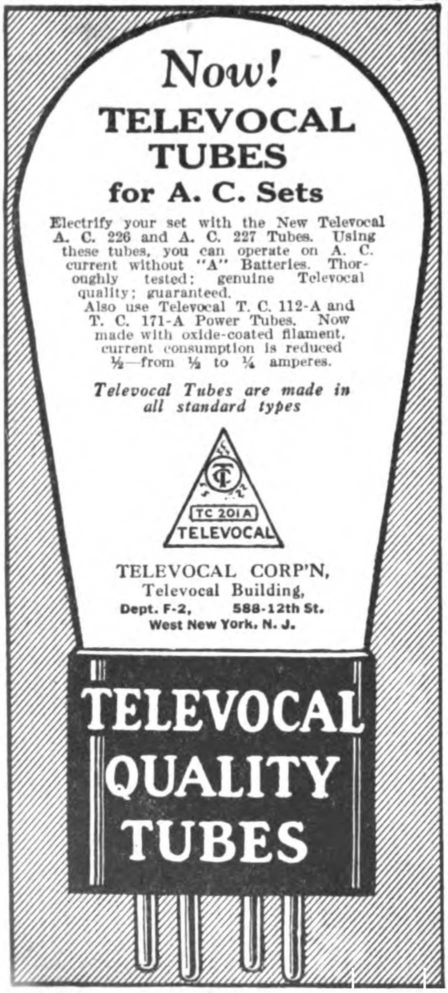
New 1927-28 Hampton-Wright Free Catalog
of Radio Parts and Accessories

Mail This Coupon Today!



Hampton-Wright, 138 Darmody Bldg., Indianapolis, Ind.
Dear Sirs: I'm interested in this new catalog of Hampton-Wright radio parts and accessories at astonishingly low prices. Send one today to:
Name__________ **Street**__________
City__________ **State**__________

HAMPTON-WRIGHT
RADIO PARTS AND ACCESSORIES
DARMODY BUILDING ✣ ✣ ✣ INDIANAPOLIS



Now!
TELEVOCAL
TUBES
for A. C. Sets

Electrify your set with the New Televocal A. C. 226 and A. C. 227 Tubes. Using these tubes, you can operate on A. C. current without "A" Batteries. Thoroughly tested; genuine Televocal quality; guaranteed.
Also use Televocal T. C. 112-A and T. C. 171-A Power Tubes. Now made with oxide-coated filament, current consumption is reduced ½—from ½ to ¼ amperes.

Televocal Tubes are made in all standard types

TC 201A
TELEVOCAL

TELEVOCAL CORP'N,
Televocal Building,
Dept. F-2, 588-12th St.
West New York, N. J.

TELEVOCAL
QUALITY
TUBES

Listed by Underwriters' Laboratories

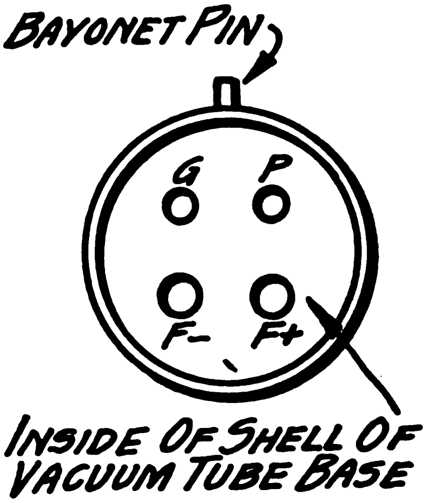
Why
Erect
An Aerial?

ELECTRAD
Lamp Socket
Antenna
$1.00

Makes aerials unnecessary and in some instances gives better results. Consumes no current. Positively SAFE. Practical, simple and neat. Insert in any outlet. Tested at 2500 volts A.C.

At your dealer's or write
Dept. 60A, 175 Varick Street,
New York, N. Y.

ELECTRAD



THE CONNECTIONS FOR THE VALVE TESTER PLUG

FIGURE 6: *Insert the leads into their respective tongues and solder them into place. The leads may then be held firmly in place by pouring wax into the shell around the wires.*

must be taken that the proper ends are soldered to their respective prongs. By referring to the diagram in Figure 6, mistakes in connecting the ends may be prevented.

It will be necessary to install a 45-volt "B" battery in the vacant space in the carrying case. The positive terminal of this battery should be connected to the binding post marked 45 positive (+), and the negative to the post marked 45 negative (—). The outfit is now complete and ready to operate. If the operation chart shown in Figure 4 calls for an "A" battery, it should be connected to the binding posts marked negative (—) and Fil. positive (+). The negative post is common to both "A" and "B" voltages.

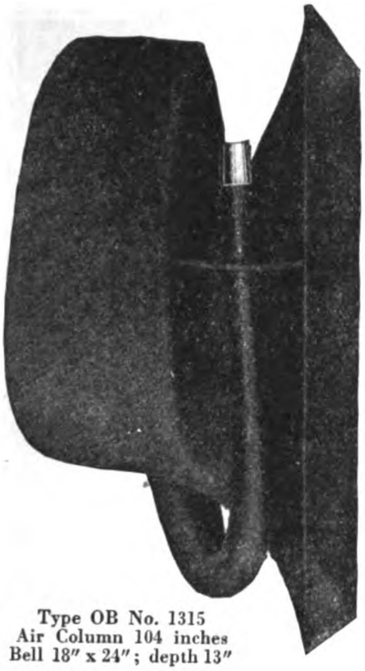
The operation of the tester may be greatly simplified by cutting out the tabulated data of operation shown in Figure 4 and pasting it on a card or on the lid of the carrying case. In this table each switch is designated by a number instead of a name, and the various operations are described by switch numbers.

Many other uses for the tester will occur to the ingenious experimenter; these will help to make the completed unit a really helpful and worthwhile addition to the "service" equipment of the radio shop or laboratory.

FOR ANY OLD RECEIVER—
The Thordarson power-pack will give the convenience of "B" and "C" power from the lighting mains, and the pep and vigor that come from the UX-210 valve power stage that it employs. Full constructional details for this unit will appear in the December number of POPULAR RADIO.

RACON EXPONENTIAL SOUND CHAMBERS

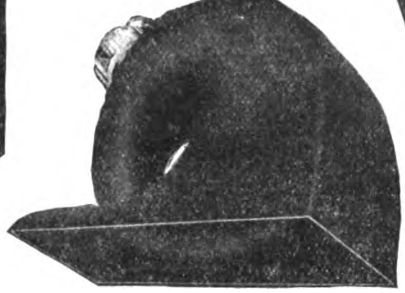
Known the World Over for Their Superiority



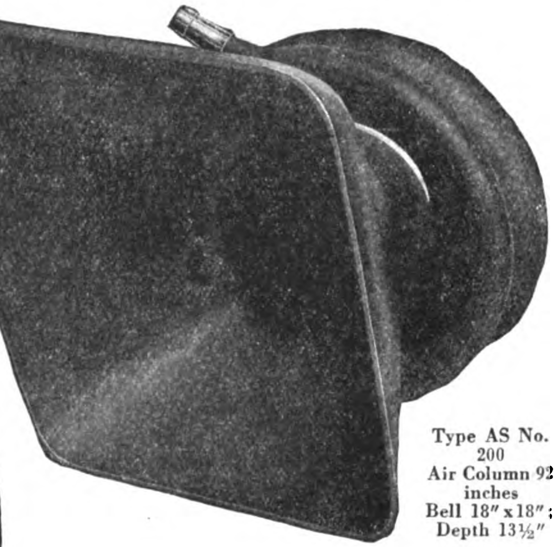
Type OB No. 1315
Air Column 104 inches
Bell 18" x 24"; depth 13"

The RACON Process assures uniformity; strength; maximum quality; minimum weight.

Racon Horns insure quality of performance much more naturally than that obtained by any other mode of amplification because of the true scientific principles of design and the exclusive material employed. Every Racon horn conforms to the latest theory of exponential design.



Type OB No. 320
Air Column 78 inches
Bell 10" x 20"; Depth 13½"



Type AS No. 200
Air Column 92 inches
Bell 18" x 18"; Depth 13½"

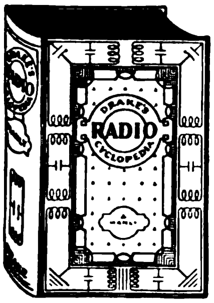
RACON Horns are made of impregnated **cloth under our own patents No. 1,507,711 and No. 1,501,032.**

For further details address

RACON ELECTRIC COMPANY, Inc.

18-24 Washington Pl. **New York, N. Y.**

LOOK!



The Last Word in RADIO

Radio is an *exact* science, yet so new there is still much that is incorrect and unscientific in present equipment. The results are faulty reception and complaints.

To meet this need we have compiled the exact facts covering the entire scope of radio science and every type of receiver into one big, fine, new book. With it you can now *Be The Man Who Knows!*

DRAKE'S RADIO CYCLOPEDIA

Solves the Dealer's Service Problems

If you design, build, repair or service radio receivers you need this book. All subjects alphabetically arranged, with hundreds of cross references so you quickly find what you want. 1672 headings, 985 illustrations, 871 pages. Nothing else like it. It is *the* book of radio, just out. SEND TODAY. $6.00 postpaid. Also for sale at all bookstores.

Big catalog of useful books sent free

FREDERICK J. DRAKE & CO.
Publishers
1011 S. Michigan Blvd., Chicago

THE
"LYNCH 5"
model
was built around
SICKLES COILS
You can expect to duplicate the exceptional results only with the same
SICKLES COILS

These are the same standard high quality accurately calibrated coils which have had no superior during the past five years. Specially designed for the

"LYNCH 5" DECK
Coil Set No. 28 $4.50

There are Sickles Diamond-Weave Coils for all leading circuits.

THE F. W. SICKLES CO.

134 UNION STREET
SPRINGFIELD :: MASS.

No.		Coil Prices
30	Shielded Transformer	$2.00 each
24	Browning-Drake	7.50 set
18A	Roberts Circuit	8.00 set
25	Aristocrat Circuit	8.00 set
28	Lynch 5	4.50 set

AMPERITE is the only automatic filament control that keeps the temperature or voltage of the tube filament constant despite variations in the "A" battery voltage. It guarantees improved tube performance and increased tube life through always operating tubes at their proper filament temperature. Simplifies wiring, panel design, tube control, tuning. Eliminates hand rheostats. Do not confuse with fixed filament resistors which attempt to imitate AMPERITE but are entirely different in principle and operation. Insist upon *Amperite.* Price $1.10 mounted (in U.S.A.) For sale by all dealers.

Write for FREE "Amperite Book" of season's best circuits and latest construction data. Address Dept. PR11

Radiall Company
50 FRANKLIN ST., NEW YORK

AMPERITE

REG. U.S. PAT. OFF.

The "SELF-ADJUSTING" Rheostat

Quali-Tone

NOW DEMANDED BY EXPERTS

Radio Engineers and Technical Editors accept Quali-Tone Loops as the ultimate in effecting highest efficiency in radio reception.

Unexcelled for Distance - Selectivity - Tone

The electrical characteristics of Quali-Tone Loops meet the demand of present day successful loop antenna receivers—resulting in Quali-Tone Loops being highly endorsed and specified as standard equipment with the better circuits.

Holds Two World RECORDS For DX Reception

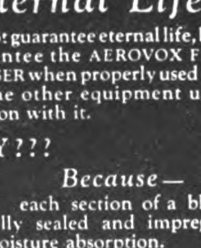
Convince yourself of Quali-Tone's superiority by comparing it with any other loop made.

Allow your set to do full justice to itself by using a Quali-Tone Loop.

The De luxe $12.50
The Quali-tone 10.00

JOBBERS write for discounts. DEALERS Send for circulars

DURO METAL PRODUCTS CO.
2655 N. Kildare Avenue Chicago



Aerovox Condensers are exclusively specified for the Magnaformer 9-8 Circuit

Eternal Life

We cannot guarantee eternal life, but we do guarantee the AEROVOX FILTER CONDENSER when properly used to outlast all the other equipment used in conjunction with it.

WHY???

Because—

each section of a block is individually sealed and impregnated against moisture absorption.

the safety factor used in manufacture, testing and rating will permit indefinite continuous operation at the rated working voltage without injury.

For all eliminators

AEROVOX
"Built Better"
70 Washington St., Brooklyn, N. Y.

Underwood & Underwood

THE "HIGH PRIEST" OF BROADCASTING

Roxy, shown seated in the center, is nationally known both as the builder of the Roxy Theatre, the "Cathedral of the Moving Pictures" and as one of the foremost of the broadcasting impresarios of the land. Behind Roxy is Frank A. D. Andrea.

BROADCAST LISTENER

Comments on radio programs, methods and technique —from the point of view of the average fan

By RAYMOND FRANCIS YATES

What Competitive Programs Are Doing to Radio

IF there is one thing that has given to broadcasting a healthy blush during the past twelve months, it is competition between commercial enterprises bidding for air popularity.

Previous to the exploitation of radio, the art lacked that competitive feature which is so necessary as a stimulant to perfection. Sadie Jones, who used to soprano to heaven that her family and friends might listen at home, had no objective in denying other studios of their customers; and the parlor baritone, motivated by the laudable ambition of nailing a small-time vaudeville job, was far from being the kind of timber needed to help broadcasting rise above the levels of very ordinary entertainment. True, studio managers were dimly conscious of a competition with other broadcasters, but their ideas of supremacy involved nothing more inspiring than the slip-shod presentation of talent which was no better than the average performance at church bazaars and Elks' Carnivals.

But commercial broadcasting has changed the complexion of the entire art.

Those who pay fancy prices for their time on the air, aim, it is evident, to make every moment worth the "B" battery current, and ham talent is again finding it necessary to take up fiddling, yodelling, baritoning, piano practice and oratory within the privacy of its own chambers.

As an instance of the value of competitive broadcasting, we point to the programs of the Roxy and Capitol Theaters in New York. Here two factors, somewhat at loggerheads, are struggling for air supremacy as a pure matter of business. Barrels of glittering mazuma are being poured into chain hook-ups with ace-high talent, and broadcasting, as a whole, has benefited greatly from the struggle.

The opening of Roxy's "Cathedral of the Motion Picture" and the broadcasting of its 110-piece symphony was immediately answered at the Capitol by the addition of fourteen pieces to its already large symphony. The hotels of the country, aiming to attract diners by their music, are engaged in constant competition—a competition that, incidentally, is of more benefit to the radio fans than it is to the dining-room receipts.

There is nothing altruistic in the efforts of the commercial broadcasters in their attempt to engage the attention of the radio audience. They are interested in results rather than in philanthropy, and on a purely competitive basis they are making every effort to entertain as many listeners as possible.

It has been this increasing competition that has prevented broadcasting from

HELLO JAPAN!

Magnaformer 9-8

Spans the Seas!

"It was not long before we located three very interesting carrier waves . . . 352, 375 and 395 meters, and from experience we knew who they were long before any announcements were distinguishable, namely, Sydney, Tokio and Melbourne. . . . When 4 a. m. rolled around JOAK was way above the fading static level, and from 4 to 5 he steadily came through with volume to fill the house. In fact, it is probable that Mrs. Tischer has since heard some caustic remarks from her neighbors, as the singing of a loud-voiced Japanese soprano in songs which seemed to be dozens of verses in length is hardly compatible with restful slumber.

—K. G. Ormiston in "Radio Doings," Sept. 17, 1927

THE world's most powerful receiver has been developed in the Magnaformer 9-8. Imagine the thrill of receiving Tokio, Japan, Sydney and Melbourne, Australia, of spanning 6000 to 9000 miles of space! Such loud-speaker performance is truly exceptional. Only the most highly perfected receiver could accomplish it.

Add to this thrill of extremely long distance loud-speaker reception, the keen enjoyment you experience from listening to the Magnaformer's sonorous, true-to-life tone, and you have an entertainment combination that cannot be equalled.

See editorial article in this issue

ADVANCED ELECTRICAL DESIGN HERALDED BY EXPERTS

By its supreme performance in the five vital essentials—tone quality, distance, selectivity, ease of handling and volume—it has well earned and truly deserves its title—"Magnaformer—the Great Creator—Commander-in-Chief of the Air," the finest radio receiver ever designed.

When such radio experts as G. M. Best of "*Radio*," L. M. Cockaday of "*Popular Radio*," K. G. Ormiston of "*Radio Doings*," the technical editors of the *Citizens Radio Call Book* and other magazines, come out month after month with enthusiastic articles in praise of the exceptional performance of the Magnaformer 9-8, you can bank on it that this receiver is remarkable and unusual.

ABSOLUTE ELECTRICAL MECHANICAL PRECISION OF MAGNAFORMERS

The secret of the tremendous power and extraordinary performance of the Magnaformer 9-8 receiver lies in the Magnaformer Long Wave R. F. Transformers. These intermediates are strictly a laboratory product, each one being peaked in the laboratory to a wave length of EXACTLY 69.73 kilocycles (4300 meters), and permanently sealed. The full and complete wave-band, with 100% of its vital, quality-producing, harmonic-carrying side-bands, is positively and easily passed through all of the Radio Frequency amplifying stages, leaving no possibility for distortion. This accounts for the exclusive degree of True Tone Quality in the Magnaformer 9-8 and its wonderful non-critical selectivity.

Everybody Who Hears It Wants One

The Magnaformer 9-8 is THE receiver everyone would insist upon having if they only knew how remarkably it performs. It is easy to build. It will give you the greatest satisfaction you have ever experienced from any radio receiver. Everyone who tunes or hears a Magnaformer 9-8 wants one immediately. Its praises are being sung by set builders everywhere. Read the construction articles in Radio, Popular Radio, Radio Doings and Call Book; or build it from the full-size official construction sheet 26" x 34", printed both sides and full of illustrations.

Easy Tuning—Powerful Reception

Stations are easily tuned in or out at will without having to be located by a micrometer adjustment of the dials. The amplification per stage is nearly double. Changes from 9 to 8 or 8 to 9 tubes instantly by means of panel switch. The use of 9 tubes is necessary only on very distant stations.

Send Now for Free Illustrated Literature

Send at once for FREE illustrated story of the Magnaformer 9-8. We will also send you testimonials such as have never before been written about any receiver. We will include the full story of K. G. Ormiston's unique experience with the Magnaformer 9-8; W. D. Scott's challenge and defeat. All this will be mailed to you the same day we receive the coupon. Don't build another set till you hear from us. Send right NOW while you have it in mind.

Radiart Laboratories Co.

19 S. La Salle St., Dept. 48
CHICAGO, U. S. A.

COUPON

RADIART LABORATORIES
19 S. La Salle St., Dept. 48, Chicago

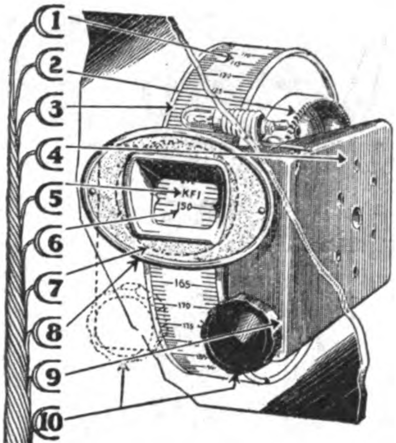
Dear Sirs: I am interested in the exceptional performance of the Magnaformer 9-8 Receiver, so please send me the Magnaformer Story, details of Ormiston's unique experience, and Scott's challenge and defeat.

Your Name...

Address...

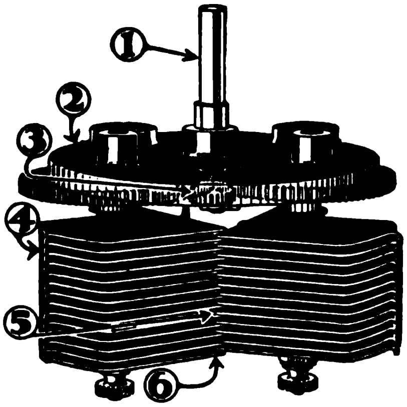
City.................................. State...........

REMLER
DRUM DIAL



① Readily changeable, white cardboard indicator strips. Supplied for clockwise or counter clock-wise reading.
② No back lash. Fine-tooth gear driven by spiral-cut pinion.
③ Station Settings spread over 15 inches of space.
④ Heavy brass bracket supports condenser; rigid construction.
⑤ Space provided for call letters.
⑥ Large, easily read figures.
⑦ Round hole for escutcheon plate; no special tools necessary.
⑧ Attractive bronze escutcheon plate.
⑨ Vernier control; Special shaft cannot bind in bushing.
⑩ Right or left hand control.

REMLER
TWIN-ROTOR
CONDENSER



1 360° rotation of shaft and reduction drive give vernier control.
2 Proper placing of insulating material minimizes resistance to radio frequency currents.
3 Complete insulation of plates from dial and dial shaft and provision for grounding dial and shaft give absolute freedom from body capacity effects.
4 Plates carefully aligned by hand and soldered rigidly in position at three points.
5 Balanced Twin-Rotor construction gives utmost smoothness of operation.
6 Shape of plates permits attainment of very low minimum capacity and wide tuning range.

Write for free folder describing Remler parts

REMLER Division of
Gray & Danielson Manufacturing Co.
260 First St., SAN FRANCISO
CHICAGO NEW YORK
Eastern Warehouse, Elkhart, Indiana

going to the bow-wows. Fortunately, the warfare for air supremacy between the various high-class studios has but started and there is every reason to believe that it will become increasingly fierce. "Circulation" on the air is put as important as circulation in a publication, and as long as soap, silk, and hot-water heater manufacturers want to dole out the mazuma, we know of one little radio listener who won't wait up to scare Santa Claus.

* *

The Joy of a Program Without an Announcer

SINCE 1923 we have—perhaps foolishly—persisted in the theory that the less heard from talky announcers the better.

Announcers have a habit of projecting themselves into the programs in a wholly unnecessary and, at times, annoying way. Quite forgetting that they are, after all, called upon to perform a function that is ordinarily performed by an inarticulate scrap of paper, they seem to be motivated by the notion that the event to follow is being presented merely as an excuse for the announcement and that they are, in the final analysis, the salt that leavens the whole broadcasting loaf.

It came somewhat as a pleasant shock to find that the Brunswick-Balke-Collender Company shared this theory with us, and that it was stubborn enough to try it out on WJZ, where announcers, although hand fed with the dainty, inane morsels prepared by special writers, are permitted to assume the acoustical proportions of a circus barker. For a solid hour of broadcasting the coterie of announcers, ordinarily very much in evidence, were absent. The wonder of it was that the program continued, smoothly and serenely, unpunctured with the verbal excursions of the studio *literati*. This particular program was deliciously unique, and besides giving Mr. Cross and his cohorts an opportunity for a cup of coffee at Childs, it proved beyond even a tiny whiff of doubt that too much windy announcing is very bad.

* *

Real Story Telling "On the Air"

WE have always felt that some day somebody would find a way of telling stories on the air. *Collier's Weekly* was doing that very thing and doing it well on the Blue Chain every Sunday night. Between the reading of the story, the appearance of the characters who act portions of it, and the judicious use of music, *Collier's* originated, to our way of thinking, a sound device for the entertainment of the radio audience that has never been matched and probably never will be.

FROST-RADIO
EXCLUSIVELY SPECIFIED
FOR THE
Magnaformer
9-8

The powerful Magnaformer, one of the season's most popular circuits, specifies Frost-Radio De Luxe Parts exclusively. Demand these quality parts from your dealer **by name**, ordering from the list below, so that you can build this great receiver right away.

FROST-RADIO PARTS
FOR THE MAGNAFORMER

1 No. S-1810 De Luxe 10-ohm Bakelite Combination Rheostat and Battery Switch, gold arrow knob.
1 No. 1824 De Luxe 400-ohm Bakelite Potentiometer, gold arrow knob.
1 No. 1810 De Luxe 10-ohm Bakelite Rheostat, gold arrow knob.
1 No. 1830 De Luxe 30-ohm Bakelite Rheostat, gold arrow knob.
4 No. 253 Frost Cord Tip Jacks.

HERBERT H. FROST, Inc.
Main Offices and Factory
ELKHART, IND.

Chicago Washington, D.C.
New York Pittsburgh
Boston New Orleans
Philadelphia St. Paul
Los Angeles Buenos Aires

The
POPULAR RADIO
Atlas *and* Log

will give you a list of all the NEW Broadcasting Stations with wavelengths and other necessary information

A Complete Atlas and Station Log

The "POPULAR RADIO International Radio Atlas and Log" will supply you with full information regarding broadcasting stations of the United States and Canada.

This most useful and practical Atlas consists of 16 pages, size 12" x 15", printed on good paper, from clear type in two colors and contains a complete series of double page maps, including—The World—The United States—Canada—North and South America, showing location of principal broadcasting, leading commercial and governmental radio stations.

SPECIAL FREE OFFER

You may have a copy of the "POPULAR RADIO International Radio Atlas and Log" free. with POPULAR RADIO for (8) eight months

For Only $2.00

Pin $2.00 in bills to the coupon below.

If you are a subscriber to POPULAR RADIO your subscription will be extended eight months.

Date............

POPULAR RADIO, Dept. 42A,
119 West 57th St., New York City.

Enclosed is my remittance of $2.00 for which you are to enter my subscription (extend my subscription) for (8) eight months for POPULAR RADIO and send FREE a copy of the "POPULAR RADIO International Radio Atlas and Log."

Name..

Address..

City........................State............

FERRANTI

FERRANTI A. F. 4 TRANSFORMERS

exclusively specified for the Magnaformer 9-8 Circuit

T*RUE Musical Reception*

. . . whether you build or buy your set!

That is your ideal, your goal in radio—true musical reception! Ferranti audio frequency transformers will give it to you, for they amplify every note faithfully, giving it the exact *tone* of the original. Even the elusive deep bass and quavering treble notes are caught and rendered exactly as they are—a transformer can do no more. Plenty of volume, too, and yet the amplified sound is always rich, mellow.

Whether you build your set from component parts or buy your set complete, make sure that Ferranti transformers are included in it. The part that they play in quality reception is so large, so important, that it is wise to use them if you want results.

Audio Frequency Transformer

TYPE AF-3 $12.00

A new and better standard for 1928 in audio frequency amplification. Confidently recommended to all who wish the best in rich tone quality over the entire broadcast range.

Ratio . . . . 3½ to 1 Dimensions 2¼" x 3" x 3¼"
Weight . . 1 lb 14 oz.

Audio Frequency Transformer

TYPE AF-4 $8.50

A Transformer giving exceptionally uniform amplification at a moderate price. All types tested to 1000 volts between windings and between windings and ground.

Ratio . . . . 3½ to 1 Dimensions 2¼" x 3" x 3¼"
Weight . . . 1 lb. 8 oz.

Output Transformer

TYPE OP-1, $10.00

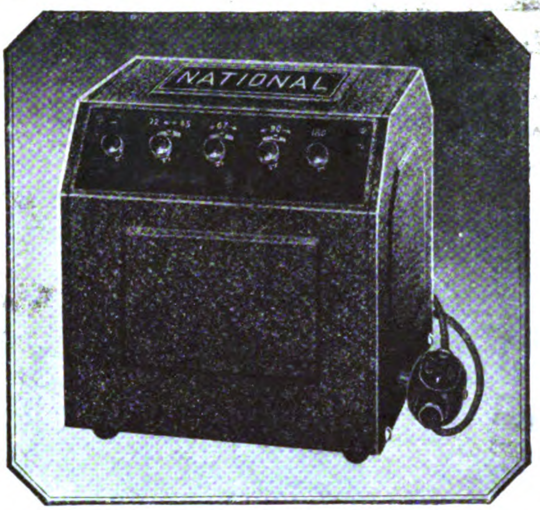
The finishing touch of the modern radio set. Will purify and improve the tone of your speaker. Prevents possible accidents from shock and burnouts by eliminating D. C. and high plate voltage at speaker.

Ratio . . . . . 1 to 1 Dimensions 2¾" x 3" x 3¼"
Weight . . 2 lbs. 10 oz.

FERRANTI *Ltd.*
Hollinwood, England

FERRANTI *Incorporated*
130 West 42nd Street, New York, N.Y.

FERRANTI ELECTRIC *Ltd.*
Toronto, Ontario, Canada



AN ENTIRELY NEW AND UNIQUE HEAVY-DUTY *BETTER*-B

SUPPLIES

Detector voltages, 22 to 45, adjustable; R. F. voltages from 50 to 75; A. F. voltages from 90 to 135; Power tube voltage 180 fixed.

AN EXCLUSIVE FEATURE

Tubes and by-pass condensers are protected against excessive and harmful voltages.

Designed for lasting service with liberal factors of safety.

A STRICTLY HEAVY-DUTY POWER UNIT

Output rating is 70 mils at 180 volts. Uses R. C. A. UX-280 or Cunningham CX-380 Rectron.

Licensed under patents of Radio Corporation of America and Associated Companies.

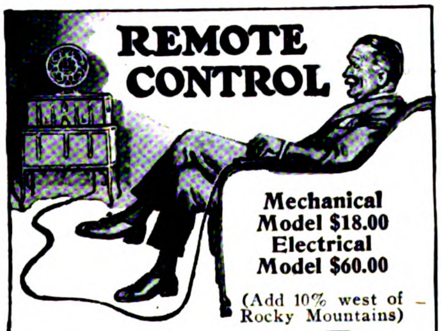
For 110-120 Volts, 50-60 cycles A. C. List price with cord, switch and plug, $40. Rectifier tube, $5.

Write National Co., Inc., W. A. Ready, Pres., Malden, Mass., for new Bulletin, L-124.

NATIONAL-B

Type 7180

A "B" That's Built for Service



Mechanical Model $18.00
Electrical Model $60.00
(Add 10% west of Rocky Mountains)

Write for illustrated descriptive circular

Imagine the pleasure of tuning your radio without having to get up once all evening! Turn set "on" or "off," tune, regulate volume—*from your easy chair!* Easily attached to any single, removable dial receiver in a few minutes.

ALGONQUIN ELECTRIC CO., INC.
245 Fifth Avenue, New York City

Algonquin

TRADE MARK REG. U. S. PAT. OFF.
REMOTE CONTROL RADIO TUNING UNIT

Set Builders! Dealers!

FREE —big catalogue

Standard parts and equipment at money-saving prices, with discounts that show you a real profit. Electrical Phonograph—pick-ups—latest kits! New A C tubes and transformers—parts for any circuit—power audio equipment—short-wave supplies—they are all in our big new 1928 Catalogue. Write for it today, with discount sheet. 12-hour shipment guaranteed.

Van-Ashe Radio Co.
204 North 10th ST. ST. LOUIS, MO.

Musical Appreciation and the Radio

SINCE the inception of radio we have heard it said again and again by the heavy thinkers of the country that such widespread distribution of the musical classics over the air will eventually make of America a nation of music lovers hungry for the delicate morsels of the masters. To our way of thinking, it will do nothing of the kind. Appreciation of the classics does not, as many of our musical educators believe, come through mere exposure to them. As a matter of fact, too much exposure to them creates boredom even with those sensitive enough to catch the elusive meanings of the great composers and esthetic enough to enjoy fully the charm of music well written and played.

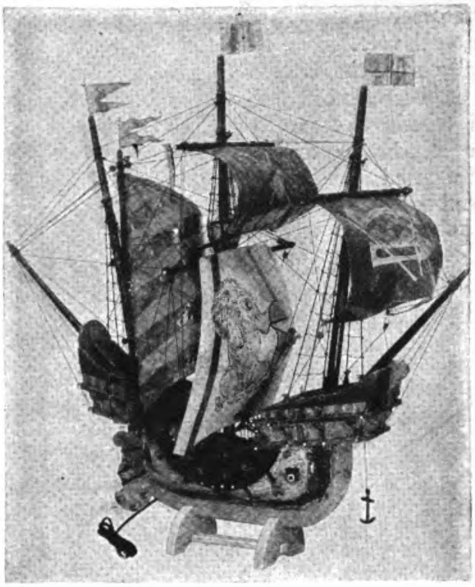
It is not always the intellectual person that best appreciates the work of the grandpas of music. There is the occasional moron, who, while his texture may not be so fine as that of the bluebloods, gets just as much solid enjoyment out of "Coq d'Or" or the "Second Rhapsody" as a college professor with black ribbon on his specks, or a patron of the arts at a Mozart tea. The real appreciation of music comes from a source more fundamental than education; an individual either likes the classics or he does not, and the cultivated taste for them is apt to be both superficial and artificial. Beethoven's "Moonlight Sonata" might reach the soul of an Amazon head-hunter more easily than the intellectual who applauds with lifted hands at the best recitals. After all, the real test of music is in the effect it produces in its listeners and not in the mere appreciation of the technique or execution. And is it not true that a knowledge of technique often destroys the esthetic effect? Getting too close to a thing often robs one of the illusion necessary for fullest enjoyment.

While the gracious ministrations of the engineers of music, in their task of exposing over the radio the technique of Bach or the melancholia and morbidity of the Russian masters as expressed in their compositions, may appeal strongly to certain people, we are of the opinion that musical education on the air is being carried to a point where it has become something of a bore. It was to be expected that Walter Damrosch's splendid series of student excursions into the ante-chambers of the art would start an epidemic of musical education and that a considerable number of our musical apprentices would be suddenly seized with the impulse to put America wise to the ABC's of their trade.

One cannot tune the set in any more without hearing one of the musical papas chiseling away at the works of one of the masters, performing what is to them and to all of the fat lady presi-

BUILD A SHIP MODEL LOUD SPEAKER

$12.50 **$12.50**



A combination of a beautiful ship model and a loud speaker that is easily worth $100. You can build it yourself in a few spare hours with no other tool than a small tack hammer.

Size: 26 inches high; 12 inches wide; 27 inches long (overall). The La Pinta, a reproduction of one of the famous Fifteenth Century ships.

The famous Melody Ship which has met with instant approval everywhere it has been shown and played, can now be purchased in knock down form at the startlingly low price of $12.50. This remarkable speaker combines

PERFECT TONE -- PLENTY OF VOLUME -- NO DISTORTION

No doubt you have often admired ship models and yearned to possess one but could not do so because the price was too high. Now it is possible to own a beautiful ship model and loudspeaker combined at a small cost. Let the WORLD'S LARGEST BUILDERS OF SHIP MODELS AND SHIP MODEL LOUD SPEAKERS supply you with all the necessary parts, cut to fit and ready to assemble from which you can build a beautiful model of the historic Mayflower, the Santa Maria or the La Pinta in a few hours. To all outward appearances the completed model is a beautiful ship model, but upon closer observation a loud speaker can be seen cleverly incorporated into the mainsail.

The loud speaker unit is of the Electro Magnet type. Power amplification is not needed to force the low tones through. They come through with perfect ease and do not interfere with the high notes, giving faithful reproduction at all frequencies. The mainmast, upon which the unit is securely fastened, is seated two inches deep in a three and a half pound solid wood hull, making it impossible for counter vibrations to affect the perfect reproduction of the Melody Sail. The driving pin is attached to our super-vibrating, especially prepared Melody Sail. The installation of the Melody Sail does not change the appearance of the model in any way. Melody ships come in three beautiful models, the Mayflower, the Santa Maria and the La Pinta, with parts cut to fit and ready to assemble. No tool needed but a small hammer.

You need not know anything about ship building or carpenter work in order to build one of these ships. No special knowledge of ship model building is necessary, either. We will supply all the parts from the hull down to the smallest piece of rigging, all cut to fit and ready to assemble. You cannot go wrong. Diagrams and plans of parts that are included with each kit tell exactly what to do with each part.

These plans show you step by step just how the model is constructed. Everything is made so simple that even a small child can build a beautiful model.

All you need is a small hammer to tap the parts into place. Here is a part of the instructions copied word for word from the diagram and instruction sheet that goes with the kits. "Take part No. 57, place it in front end of part No. 56 and tap lightly with a hammer. Next take part No. 58 and place it up against No. 57 and tap it with a hammer to bring it into place."

Easy! Nothing simpler. The instructions are like that from beginning to end. Do this and that and before you realize it a beautiful ship model has grown before your eyes.

Write for our free beautifully illustrated catalog, which contains photographs of all our models, together with complete details and price of each. We will send this catalog without obligation to you. Fill in the coupon below and we will act upon it immediately.

If, after assembling the model according to our instructions, you do not think it worth many times the purchase price, return it to us in good condition and we will gladly refund your money.

MINIATURE SHIP MODELS, Inc.
3818-20-22-24 Baring St., Philadelphia, Pa.
Canadian Branch: 1485 Bleury St., Montreal, Canada
Canadian Prices Slightly Higher. Send all [illegible] Orders

MINIATURE SHIP MODELS, INC., DEPT. W2
3818-20-22-24 Baring St., Phila., Pa.

Please send me complete parts, cut to fit and ready to assemble for the Melody Ship .... for which I agree to pay postman $12.50, plus postage.

PLEASE PRINT NAME AND ADDRESS PLAINLY

Name..

Street or R. F. D...................................

City...

State..

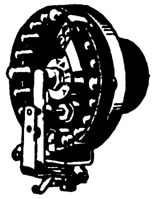
YAXLEY APPROVED RADIO PRODUCTS **For Radio Fans with Exacting Demands**

Automatic Power Control

You can get greater pleasure through your radio set with this great convenience. It eliminates fussing with your radio when you turn it on or shut it off. The Automatic Power Control switches on the B eliminator and cuts out the trickle charger when you turn on the set. The B eliminator is cut out automatically and the trickle charger cut in when the set is turned off. Controls both B eliminator and trickle charger in combination or switches either eliminator or charger separately when either is installed alone. Makes your receiver a power operated set.

No. 444—Series Type. With the exclusively Yaxley feature that keeps the voltage drop less than two-tenths (2-10) volts when used with sets having a current draw equivalent to four 199 type tubes up to eleven 201 type tubes......... **$5.00**

Air-Cooled Switching Rheostat



An ideal combination for modern radio receivers. Controls the switching of the set and at the same time permits building up of filament voltage slowly and holding it at exactly the right point for perfect reception. Furnished complete with Bakelite knob. 2 to 100 ohms....................................each, **$1.75**

At your dealer's. If he cannot supply you, send his name with your order to

Yaxley Mfg. Co.
Dept. P, 9 So. Clinton St.
Chicago, Ill.

The Coil's the thing that makes Radio

DUDLO

NO RADIO UNIT IS ANY BETTER THAN ITS COIL

The performance of Battery Eliminators, Audio Transformers, Loud Speakers, and all other Radio Units is in exact ratio to the efficiency of their windings. **It's the Coil that does the work!**

Nearly all leaders in radio and radio parts use Dudlo Coils because they know their superiority.

DUDLO

Dudlo Manufacturing Corporation
FORT WAYNE, INDIANA

It has become standard practice to use

PARVOLT
CONDENSERS

in circuits that break down ordinary by-pass condensers.

You will find that the same characteristics of accuracy, high direct-current resistance, and the ability to give continuous duty, at full rated voltage, make them desirable in circuits where even a poor condenser might "get by."

The Acme Wire Co.
New Haven, Connecticut
6131-6

dents of Mozart societies throughout the country a perfectly laudable effort to penetrate the dark recesses of the boob American mind with the soft, mellow light of musical appreciation—a light that heretofore has found its way into the skulls of only the few. We have, though it at times caused us great pain, listened to many of these "educational" lectures on musical appreciation, and we must confess that this high-sounding talk has, for the most part, been practically valueless to us. As a matter of fact, we do not want to understand music too thoroughly from the technical point of view, and we resent the attempts of the connoisseurs to correct our delinquency. An understanding of music too often brings only disillusionment. A bootblack in the gallery is lifted almost out of his red flannel underwear by the "Miserere," while the stiff-shirted critic sits in the orchestra listening for musical loose-screws and off-color technique. In the one case the appeal is to the emotions, in the other to the fugitive notion of technical perfection.

We ask of music only the power to inspire us and, incidentally, we ask of those who understand it only to keep right on with the work of interpretation, et cetera, and to realize that not everybody in America is even mildly desirous of sharing their knowledge. After all, there is little definite or tangible substance to music, aside from the concrete science associated with its purely physical side. When you leave beats, wavelengths, harmonics and the rest of sound phenomena out of it, you must, perforce, launch yourself into the more esthetic realm where one man's version is just as accurate as another's. Mendelssohn, you know, could have called his "Spring Song" "The Sleigh Ride" and it would have fitted the music just as well.

Perhaps we have said too much about this subject. If we have created the impression that all musical exposition is taboo with us, we wish to correct it. We enjoyed every one of Damrosch's lectures because they were not so technical that they robbed their listeners of emotional response to the subjects of his discourses. Then, too, his reflections on the Wagnerian operas were of such a nature that one could absorb them without fear of being disillusioned by their execution. We never fail to appreciate the sympathetic sketches of Milton Cross. What we object to is the persistent effort to make of radio one vast institution for musical discussion and analyzing. We want to enjoy music, we do not want to eat it. And we want to enjoy it in our own way, with pleasure and relaxation, and without the interference of a flock of long hairs who would have us listen with furrowed brows and eardrums straining for the slightest imperfection.

NEW!

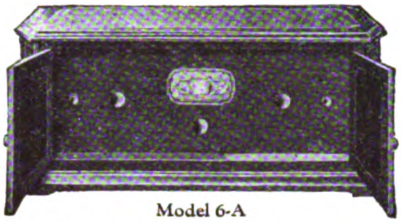
the Official

BROWNING-DRAKE

Two Tube Kit Set

This new assembly, the two tube Official Browning-Drake, has been designed to be used with any good audio transformer system now on the market, such as Amertran, Thordarson, etc. The combination gives a remarkable tone quality and great volume. This two tube assembly uses only the detector and R. F. tubes. Special type T foundation unit makes construction easy. The official Browning-Drake kit is used. Other Browning-Drake Corporation products incorporated in the assembly are the cartridge resistance and the neutralizer.

COMPARE!



Model 6-A

COMPARE Browning-Drake tone quality with that of any other popular receiver now on the market. Your own ears will at once appreciate the superiority of Browning-Drake reproduction.

Model 6-A has six tubes. Single dial illuminated drum control simplifies tuning. Conventional Browning-Drake circuit is used incorporating famous Browning-Drake slot-wound R. F. transformer in latest and improved form.

Important parts are completely shielded. Cabinet is beautiful two-tone Duco walnut. Length, 27 inches; depth, 15 inches; height, 11 inches. Price without tubes and batteries, $105.

BROWNING-DRAKE CORPORATION
CAMBRIDGE . . . . MASS.

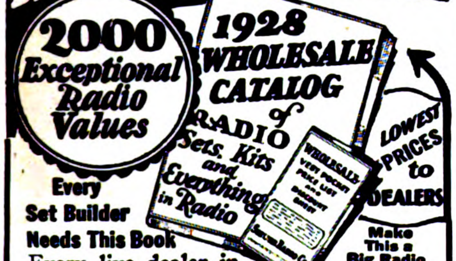
DEALERS: Write or wire TODAY for further information on the Browning-Drake line of factory-built receivers and the Browning-Drake line of parts.

BROWNING
TRADE MARK
DRAKE

Cabinets
Parts

Receivers
Kits

RADIO CATALOG *free*


2000 Exceptional Radio Values
1928 WHOLESALE CATALOG of RADIO Sets, Kits and Everything in Radio
WHOLESALE VEST POCKET PRICE LIST AND DISCOUNT SHEET
LOWEST PRICES to DEALERS

Every Set Builder Needs This Book

Make This a Big Radio Season!

Every live dealer in radio sets, parts, accessories, supplies, etc., should have a copy of this bargain catalog. You will be amazed at the thousands of money-saving radio items illustrated and listed in this storehouse of everything you could possibly need in radio.

The GUIDE BOOK to Bigger RADIO PROFITS FOR YOU

The book contains all the latest and most popular kits—all the famous, nationally known radio parts, accessories and supplies—the very newest types and designs of table cabinets and consoles—everything at prices that mean bigger profits for you.

Short Wave Section Our catalog contains a section devoted to a showing of the highest grade short wave receiving and transmitting apparatus. Also the finest electrical appliances for use in the home.

Dealers Make More Money! Tie up with a house that carries large, complete stocks, that gives you the highest quality radio parts, that insures speedy shipments and 100% satisfactory service. Our wholesale vest pocket price list and discount sheet and catalog will be sent to you on request.

BUT WRITE QUICKLY
SHURE RADIO COMPANY
339U West Madison Street Chicago, Illinois

Radio's Finest 3-ft. Cone Speaker

No. 3 Kit complete
$13.50
for 3-Foot DOUBLE Cone Speaker

G-R-P
3 FOOT CONE SPEAKER
Build It Yourself

IN one short hour or less you can assemble the finest speaker you ever heard. G. R. P. Simplified Assembly makes experts of novices; and the finest unit and other parts that can be designed and built assure you a speaker of unequaled tone quality. Reproduces all frequencies within range of human audibility — the low notes as well as the high. Operates perfectly at all voltages; will not lock or rattle.

No. 4 Kit complete
$10.50
for 3-Foot Single Cone Speaker Wall Type

G. R. P. Unit is only Double Adjustable 4-pole, balanced armature unit. Same unit furnished with both kits.

Ask Your Dealer

for genuine G. R. P. Kit—either No. 3 or No. 4. Refuse substitutes; if your dealer will not get them for you, we will supply you direct f.o.b. N. Y. C., on receipt of price.

Write for **"How to Build 7 Practical 3-Foot Speakers,"** by C. Denton; price 50c.; for a limited time sent for 10c.; coin or stamps. Write for your copy today.

Penn Radio Sales Co. ***Selling Agents***
104—5th Avenue Suite 2757 New York City

MAGNAPHON

ELECTRICAL RECORD REPRODUCER

Price $12.50

Will make the old type phonograph or any of the small portables perform like the new Electrical Reproducing Machines costing from $350 to $1,000.

The richness and tone range of the reproduction obtained by means of the MAGNAPHON will prove really amazing.

The deep bass notes, the drum beats, the very high notes, will all issue forth with a life-like mellowness and brilliance.

TWO PATENTED FEATURES

1. A peep-hole in the back of the instrument, making the position of the armature visible.
2. Adjustment screws with which the armature can be recentered if necessary.

EASILY INSTALLED

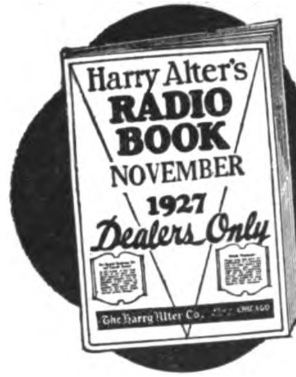
No adjustments—No removal of old sound box or fishing for correct angle is necessary. Just place the MAGNAPHON alongside the tone arm and insert the plug into the detector socket.

FROM YOUR DEALER OR US

If your dealer cannot supply you and will not get it for you, we will ship you direct on receipt of money order for $12.50.

Tectron Radio Corporation
1270 Broadway New York

FOR RADIO DEALERS ONLY



ROCK BOTTOM PRICES ON EVERYTHING IN RADIO

Only the newest and latest (1927-1928) radio goods; no obsolete products; no "seconds" or sub-standards. All goods of tested and proved quality and established reputation — absolutely guaranteed.

***Get this Wonderful* NEW PRICE GUIDE**

Compare its money-saving values. Test our "Minute-Man" shipping service with a trial Rush order. Write *now* for your copy of Harry Alter's new "Radio Book."

The Harry Alter Co.

1749 Michigan Ave. CHICAGO

MAIL THIS COUPON

The Harry Alter Co.
1749 Michigan Ave., Chicago
Send at once a copy of your November price guide.

Name ....

Address ....

City .... State ....

The Hammarlund Hi-Q "Six"

(Continued from page 317)

shields in the grooves in the corner posts and in the partition posts.

The last job is to attach the two rocker arms to the cam operating assemblies, R7 and R8, so that they engage properly with the two cams on the drum dial, F.

This completes the construction and wiring work, and the receiver is ready for operation.

How to Install and Operate the Receiver

Place the receiver in the cabinet chosen for it and connect the Yaxley cable, Q, to the "A," "B" and "C" batteries as shown in Figure 4. Then connect the cable to the plug, Q, first being sure that the battery switch, K, is turned in the "off" position, and the rheostat, J, is rotated all the way in a counter-clockwise direction.

The antenna and the reproducer should now be connected to their proper binding posts.

Insert five UX-201-a type valves in sockets N1, N2, N3, N4 and N5, and insert a UX-112 type vacuum valve in socket N6. Next fasten the tops of the shields.

All tuning is accomplished by means of the double drum dial. Turn "on" the battery switch, K, and advance the rheostat, J, all the way, Then rotate the two knurled discs simultaneously at approximately equal settings until a station is tuned in, when the volume may be readjusted with the rheostat to a suitable value. A more careful setting of each of the drums may then be made.

During a series of tests in the heart of New York City all local stations were easily tuned in with realistic tone quality and without interference or background noises. In one evening, between the hours of 9:00 and 11:00 P. M., twenty-four stations were received through the locals. In broad daylight, signals from Schenectady and Philadelphia were tuned in on the loudspeaker at will.

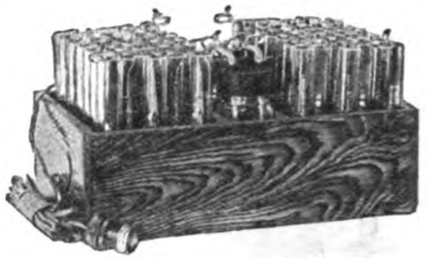
The set will not squeal or howl and will not radiate or interfere with neighbors' reception. It may be mounted in a beautiful cabinet that will fit in with the best furniture in the home.

Once installed, the set will need no future tinkering or adjustment.

For experimenters who require additional details of theory, construction, and operation, as well as a full-size picture diagram, a 48-page manual may be secured from the manufacturers.

The set is recommended to the discriminating radio fan for all-round operation, and once installed should give full satisfaction indefinitely.

90 Volt Power Unit :: $12.75



Hums, line noises, etc., positively impossible with this new advanced unit. Plug in and forget. Non-acid and noiseless. All detector and intermediate voltages plainly marked. Simpler to hook up than dry cells. Operates any type set 1 to 12 tubes. Greater volume and clearness guaranteed. If not thoroughly satisfied, return after using 30 days for complete refund. Guaranteed further 2 years. For 110-120 volts AC 25 to 60-cycle current. 90 volts, $12.75; 112½, $15.25; 135, $17.50; 157½, $19.50; 180, $24.00; 202½, $26.00.

Also built for DC current, 110 and 32 volts, at only $3.00 additional, any size above. Ample stocks—same day shipments. Simply say—ship C.O.D. or write for my interesting literature, testimonials, etc.

B. HAWLEY SMITH

340 Washington Ave., Danbury, Conn., U. S. A.

SAMSON

Chooses TOBE CONDENSERS for the Samson Power Amplifiers

The unfaltering, true and powerful quality of this fine Radio instrument matches the unfaltering strength of TOBE Condensers and we have not been able to find any kind of a Delilah that will break down TOBE strength.

Just the same, when the orchestra plays Samson and Delilah, the haunting reality of it will ring truly and clearly on the Samson Power Amplifier, and the TOBE'S will insure its being just as good next year as now. Used also in the Samson Block for the official Hammarlund-Roberts Hi-Q.

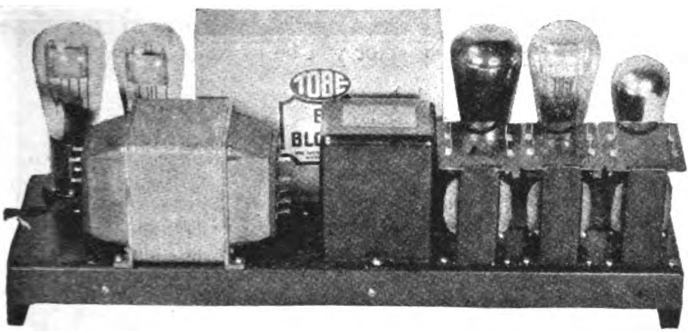
TOBE-SAMSON B BLOCK No. 713
using one 171 Power Tube
TOBE-SAMSON B BLOCK No. 718
using two 171 Power Tubes in Push Pull
TOBE-SAMSON B BLOCK No. 210
using two 210 Power Tubes in Push Pull
TOBE-HAMMARLUND-ROBERTS
OFFICIAL B-BLOCK for Hi-Q Set

Write for TOBE Power Pamphlet with descriptions of Power Circuits and prices of TOBE B BLOCKS

Tobe Deutschmann Co.
Cambridge Mass.

SM

The LC-28 Audio Amplifier



FOR the preferred audio frequency amplifier and power supply unit for the new LC-28 receiver, Laurence M. Cockaday called upon S-M engineers to have an amplifier designed to his exact specifications. The LC-28 Unipac is Mr. Cockaday's own selection—the ideal low frequency amplifier for the LC-28 receiver; and the two together provide a perfectly coordinated tone and power combination.

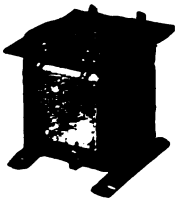
The LC-28 Unipac is a two-stage light socket operated power amplifier using one CX-326 A. C. tube in the first stage, and a CX-310 super power amplifier in the second stage. A combination of the new, specially developed, S-M 240 audio and 241 output transformers gives perfect tone and uniform amplification to all frequencies from below 100 to above 5000 cycles. The CX-310 tube, with a full 425 volts on its plate, results in beautiful rounded tone with ample volume, while the power supply, furnishing all ABC power to the Unipac amplifier, also supplies B potential to the LC-28 receiver at 45 and 90 volts, with automatic glow tube voltage regulation.

Like all other S-M Unipacs (push-pull 171 or 210 types) the LC-28 is housed in a beautiful brown crystal-finished steel case which protects all parts and safely encloses all tubes and high voltages—for over 475 volts is delivered by the full wave rectifier using two CX-316B or CX-381 tubes.

Though especially designed for Mr. Cockaday's new set, the LC-28 Unipac will operate as an entire two-stage power audio amplifier and B power supply with any receiver at all. Used to replace the entire audio system of older receivers, it will also eliminate all B batteries and provide a quality of reproduction which is a positive revelation in tonal beauty.

The LC-28 Unipac may be procured from any good dealer as a kit ready to assemble, priced at $81.25, or individual parts may be procured if desired.

1 S-M Super power transformer	$18.00	4 Frost 253 tip jacks	.60
1 S-M 331 Unichoke	8.00	1 Van Doorn chassis and cabinet	8.00
2 S-M 240 audio transformers	12.00	3 Eby binding posts	.45
1 S-M 241 output transformer	5.00	20 Ft. Kellog hook-up wire	.20
1 Tobe 662 Condenser bank	18.00	2 Frost FT-64 resistors	1.00
5 S-M 511 tube sockets	2.50	1 Frost F-1000 resistor	.50
1 Ward-Leonard 651 resistor kit	7.00	Total	$81.25



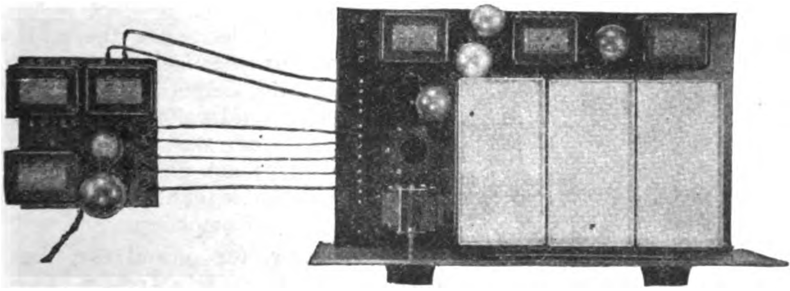
New S-M Transformers

Two new S-M audio transformers are now available, designed especially for Mr. Cockaday's LC-28 Unipac audio amplifier. Type 240, 3:1 ratio audio provides practically the same characteristics as the famous S-M 220, the largest selling high grade audio transformer, except for slightly less accentuation of notes below 80 to 100 cycles. Type 241 output protects speaker windings and boosts low note reproduction. Used together, a pair of 240's and a 241 provide an ideal audio amplifier in small space, at low cost, and with low power consumption—and they provide the 5000 cycle cut-off so necessary under present broadcast conditions to keep heterodyne squeals and noise at a minimum. Due to their small size, these transformers will fit in almost any of the older receivers, and once installed, will work wonders in tone quality improvement. Size 3 7/16 inches high, 2¼ inches wide, 2⅝ inches deep, weight 2 lbs. 4 oz. each. Price, 240 audio, $6.00; 241 output, $5.00.

S-M audio transformers hold the record again this season—for largest sales in their class—and again for specification for more circuits than any other types!

SILVER-MARSHALL, Inc.

844 West Jackson Blvd. Chicago, U. S. A.



The A. C. Improved Shielded Six is ready—a completely light socket operated battery-less set using the new A. C. tubes. It's illustrated above, with its complete dry ABC power unit—less than 7 inches square.

If you want all data on the LC-28 Unipac, the new transformers, and the Light Socket Improved Shielded Six, just drop the coupon below with 10c to cover mailing in an envelope, and we'll send it all to you.

SILVER-MARSHALL, INC.
844 West Jackson Blvd., Chicago.

Please send me all data on the Unipacs, Improved Shielded Six new transformers, ABC power units, etc. Enclosed is 10c to cover postage.

Name..

Address..

Mr. John Harrison Hartley
Using Corwico Radio Wire
Again Wins the
World's International
Set-Building Championship

CORWICO

New!

BRAIDITE

HOOK-UP WIRE

"The Braid Slides Back'

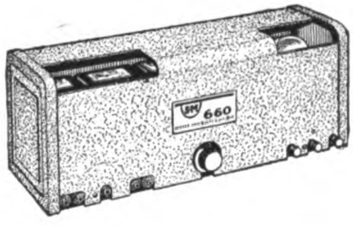
Braidite is the neatest, fastest and easiest working hook-up wire made. In making a connection it is not necessary to strip back the insulation. Simply push it back, and after soldering the insulation slides right back into place, leaving no exposed sections of bare wire. Braidite holds its shape permanently after bending, and you cannot scorch or burn it with a soldering iron.

For Best Results **Use Corwico Radio Wires**
Sold by All Dealers

CORNISH WIRE COMPANY
30 Church St., New York

"CORWICO" RADIO WIRES
"Best from the Ground Up"

- Antenna Wire (Solid Stranded and Braided)
- Complete Aerial Kits
- Magnet Wire
- Battery Cable
- Bus Bar Wire
- Hook-up Wire
- Lead-in Wire
- Annunciator Wire
- Loop Aerial Wire
- Litz Wire
- Flexible Wire



IMMEDIATE DELIVERY ON

LC-28 UNIPAC
Laboratory Super
Silver Shielded Six

Send your order to us—immediate shipment—on **all** parts for the LC-28 Unipac—the amplifier and power supply described in this issue of Popular Radio. The Unipacs are recognized as the **finest** for pure undistorted power output—supplying all A, B and C power to the audio amplifier and 45 and 90 volt B voltages to the receiver as well. Complete parts for the LC-28 Unipac $81.25. We can supply all other standard S-M Unipacs from stock, at regular prices.

Immediate delivery can be made on the famous Improved **Laboratory Receiver—the eight tube receiver which is taking the country by storm—the most selective, sensitive and powerful set you can build. Complete parts—tested, matched and guaranteed—$89.45. If two individual stage shields are desired add $4.00 for both shields.**

We can also supply immediately, complete kits on the famous Shielded Six—the receiver universally acknowledged for its purity of tone and distance getting ability. Can be built either for complete light socket operation or for battery or eliminator operation. The 630 Shielded Six kit for battery or eliminator operation is $95.00—for complete AC operation $99.00. Complete parts for the 652A, ABC power supply for the light socket operated Shielded Six $36.50 or completely wired (less tubes) $40.50.

Complete literature available—send for it and let us save you money on all standard apparatus.

SETBUILDERS SUPPLY COMPANY
514 South Peoria Street Chicago, U. S. A.

Your Neighbors Will Pay You $75.00 a week *for Your Spare Time*

You can easily sell them your spare hours for $3 each by serving as "radio doctor," building them sets, selling them supplies at less than retail. A membership in the Association shows you how to cash in on Radio now and trains you for the $3,000 to $10,000 openings awaiting qualified men. The Association starts you in business if you wish. Investigate all it has done for others, all it can do for you. A MEMBERSHIP NEED NOT COST YOU A CENT.

Earn $500 in Spare Hours

Our members are making big money with Radio. Werner Eichler, N. Y., earns $50 a week—Lyle Follick, Mich., has earned $500—F. J. Buckley, Mo.—makes as much as he receives from employer—**all in spare time.** Our members are starting radio stores, getting better **positions, increasing their salaries, earning money spare time.**

ACT NOW—for No-Cost Membership

Limited number of these memberships now available. They need not—should not—cost you a cent. To secure one, write today for details and our book, "Your Opportunity in the Radio Industry" that will open your eyes.

Radio Association of America
Dept. PR-11, 4513 Ravenswood Ave., Chicago

Send me your book and details of your Special Membership Plan.

Name ....

Address ....

City ....**State** ....

The Autobiographies of Valves

(Continued from page 344)

The amplifier valve is also tested under heavy loads with a large signal voltage, usually at 60 cycles frequency. This signal is applied to the grid of the tube and the change of plate current is obtained from the secondary of a transformer through the primary of which the valve's plate current is passed. This secondary current is passed through a thermocouple, the voltage of which is read on a hot-wire microammeter. The formula in terms of the valve factor will be as follows:

$$I_{ac} = \frac{Mu \qquad e_g}{\sqrt{(R_i + R_x)^2 \times X_x^2}}$$

Where I_{ac} = AC plate current in amperes
R_i = internal resistance of the valve in ohms
R_x = external circuit resistance in ohms
X_x = external circuit reactance in ohms
Mu = voltage amplification factor
e_g = alternating e.m.f. applied to the grid in volts

Other factors, such as a spilling of electrons around the end of the grid, may enter at heavy loads in poorly designed valves which have, perhaps, a high mutual conductance, to change the heavy-load amplification power of the valve. However, mutual conductance will usually give an indication of what may be expected of a vacuum valve as an amplifier under certain conditions, assuming other factors to be right. As mu stays about the same and as the impedance drops rapidly when the voltage of the plate and grid system is increased, it may readily be seen that this ratio and consequently the amplification of the valve increases rapidly with increased plate and grid voltages.

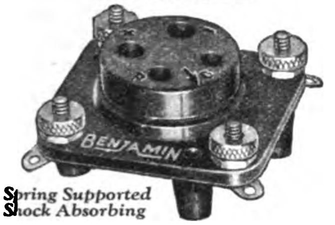
The fact that a valve has a high amplification factor does not necessarily mean that the tube will be a good amplifier. This may be seen if the impedance is increased as fast or faster than the amplification constant. In fact, the mutual conductance usually falls off at a given voltage in "high mu" valves. This occurs because a high amplification constant is usually obtained by increasing the grid wire size or turns per inch, in this way increasing the output impedance at a given plate-grid voltage as much as or more than mu was increased. Valves of this type are useful where voltage amplification is desirable, as in resistance-coupled amplifiers.

However, for general use, the tendency of modern power amplifier vacuum valve design is towards a lower amplification constant and output impedance and a consequent higher mutual conductance. The UX-120 valve has an amplification constant of 3.0 instead of 7.0, as is the case with the regular

BENJAMIN

TRADE MARK

Cle-Ra-Tone Sockets



Spring Supported
Shock Absorbing

USED the world over by set builders who know and want the best.

Stop tube noises. Anti-microphonic. The greatest contribution to the non-noisy operation of the set.

Tube "floats" on finely tempered springs. One-piece terminal to tube connection. Knurled nuts for binding post connections or handy lugs for soldering.

The choice for practically every prominent circuit for several years. Among the most recent hook-ups for which it has been specified are:

Magnaformer 9-8, L. C.-28, Camfield Super-Selective 9, Lynch Suppressor Circuit, H. F. L. Nine-in-Line, World's Record Super 10, Strobodyne 8, Melo Heald Fourteen, St. James Super, Two-Dial Equamatic.

At all Radio Jobbers and Dealers

Made by

Benjamin Electric Mfg. Co.
120-128 S. Sangamon St., Chicago

247 W. 17th St.
New York

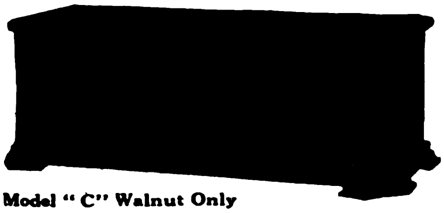
448 Bryant St.
San Francisco

Manufactured in Canada by the Benjamin Electric Mfg. Co. of Canada, Ltd., Toronto, Ontario

---

Corbett Cabinets

That Add to the Coziness of Any Home



Model "C" Walnut Only

The ultimate in elaborate and attractive radio furniture is offered in our model "C." It is an adaptation of the old Italian Chests, being designed and decorated in the spirit of the Renaissance period.

The back is grooved into place, and no nails or screws are used on any exposed surface. The front is grooved for 3/16" panel, the top rail being removable. Fancy folding top stay and piano hinge are applied.

PRICE LIST
MODEL "C" CABINETS
Walnut Only

Panel Size	10 in. deep	12 in. deep	Weight	Mounting Boards
7x18	15.50	17.00	26	.90
7x21	17.00	18.50	28	1.00
7x24	19.00	20.50	31	1.10
7x26	20.50	22.00	34	1.20
7x28	.....	23.00	37	1.30
7x30	.....	24.00	40	1.40

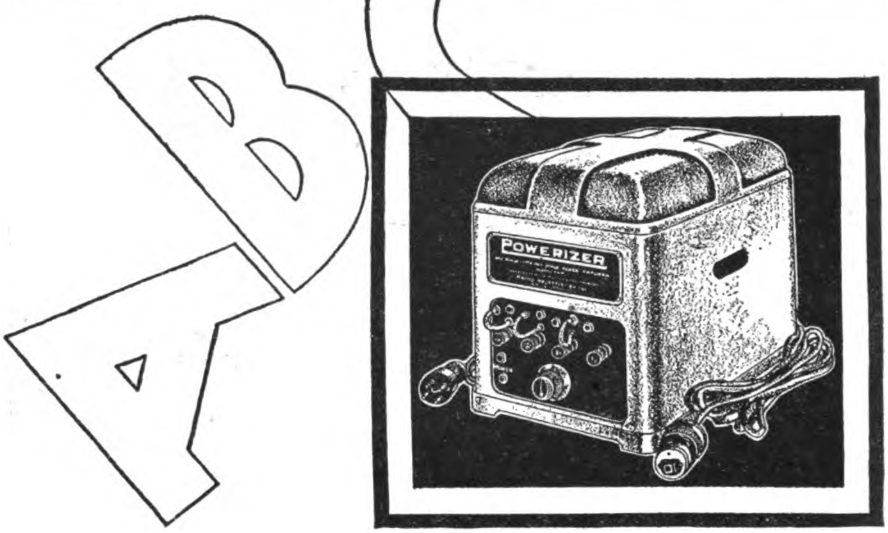
LC-28 CABINETS

Mahogany $18.00 Walnut $18.00

In stock ready for shipment
Write for illustrated folder

Corbett Cabinet Manufacturing Company
ST. MARYS, PENN.

POWERIZER



Model for Atwater Kent and other standard sets $60
Radiola "20" model without tubes, $59

MAKES YOUR SET AN A. C. ELECTRIC

with the newest A. C. Radiotrons which require no batteries!

Cymbals crash . . . the great bass booms . . . the baritone sax sighs and moans . . . dance music with jungle deep intonations . . . music such as you've never heard from your radio before . . . With the Powerizer, all those elusive low notes are captured — and reproduced with a rich mellowness.

Equip your set with a Powerizer and the finest tone quality in Radio is yours — for there is installed in your set the same system of A. C. Radiotron electrification that is used in the finest $500 and $800 A. C. Receivers.

Write for literature explaining details "How to make your set a modern A. C. Electric".

RADIO RECEPTOR CO., INC.
106 Seventh Avenue - New York

LICENSED BY RADIO CORPORATION OF AMERICA *and Associated Companies*

UX-199 valve. The impedance is also much lower.

Because of this fact and because of the greater electron emission from the larger filament to supply a greater plate current, and furthermore because this valve has a high negative grid bias, it gives great power amplification. It is superior to the UX-199 valve for operating a cone or horn reproducer, when used with 135 volts on the plate and 22.5 volts (negative "C" battery) on the grid. The lower impedance and high negative grid bias both make for distortionless amplification; the latter prevents the grid from drawing current and loading up the input circuit on loud signals with consequent high grid swings.

The UX-171 and the UX-112 valves are characterized by a still lower output impedance, a still higher positive plate voltage (180) and a still higher negative grid bias (—40½). Not only will a UX-171 type valve give a *much* greater improvement in quality, when amplifying strong signals, without overswinging the grid bias, but also a greater volume. Thus, contrary to popular opinion, there is a greater change in plate current for given change in grid voltage on a UX-171 type valve having a mu of 3 than on a valve such as the UX-240 having a mu of 30.

For example, an amplifier using two UX-171 type valves and proper low-frequency transformers together with an output condenser and choke across a cone reproducer, such as the Radiola Model 100, gives a volume and quality of reception that is a revelation to the listener. The filaments may be run directly from the AC mains (through a transformer with center tap) and the "B" and "C" voltages may be obtained from a power-pack, thus making the amplifier completely AC operated.

The UX-210 type valve has more power than the UX-120 and UX-171 type valves and its filament will stand a higher positive ion velocity bombardment without losing its film of thorium before the end of its normal life. This fact makes it possible to employ a higher plate voltage, such as 400 volts (without too great a plate current), with this valve, and to obtain a still better quality. The large amount of emission available in this tube permits distortionless amplification at extreme volumes.

For this reason such reproducers as the Rice-Kellogg, as exemplified in the Radiola 104, employ a valve of this type—which, by the way, may be lighted from the lighting circuit, thus conveniently supplying the greater filament energy needed. A "B" power-pack may be used to supply the plate current.

Plate current is dependent upon impedance and not, as is often thought,

First in the Field Specializing in Cockaday Kits

S. HAMMER RADIO CO., 303 Atkins Ave., Brooklyn, New York

Cockaday Sets Now Made Easier to Build by Our New "Ready-to-Wire" Plan

50% of Your Time, Work and Worry SAVED!

All you need do is to connect bus-bar according to diagram, solder and your set is finished. These Kits are sent to you completely mounted, and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved. Genuine parts used as listed below; exactly as used in Mr. Cockaday's Laboratory Model. COMPARE OUR OFFER!

***NEW!* COCKADAY LC-28 RECEIVER**

4 Hammarlund Mid-Line Variable Condensers, .000275 mfd. @ $5.10	$20.40
1 Hammarlund Double Drum Dial	6.00
1 Set of Precision Radio Frequency Transformers, type 4-B	12.50
3 Samson High Frequency Chokes, type No. 125, @ $2.25	6.75
1 Samson High Frequency Choke, type No. 85	2.00
3 Aerovox Moulded Condensers, .02 mfd., @ $1.50	4.50
1 Aerovox Moulded Condenser, .00025 mfd.	.35
1 Aerovox Moulded Condenser, .00075 mfd.	.40
1 Yaxley Combination Switch and Rheostat, 6 ohms, No. 906-K	1.75
1 Yaxley Cable Connector Plug with Cable, type 660	3.00
4 Carter Fixed Resistance 4 ohms, type H-4, @ 25c	1.00
2 Carter Imp. Plugs and Tip Jacks, marked "antenna" and "ground," respectively, with insulating washers for antenna jack. Complete set	$0.65
4 Benjamin Vibrationless Sockets @ 75c	3.00
1 Lynch Single Resistance Mountings	.35
1 Lynch Suppressor, 500 ohms	1.50
1 Lynch Suppressor, 600 ohms	1.50
1 Lynch Suppressor, 700 ohms	1.50
1 Durham Metallized Resistor, 6 meg	.50
2 Tait Brackets	2.00
1 Alcoa Aluminum Chassis	7.50
4 Sets Special Aluminum Box Shields for LC-28 @ $2.00	8.00
1 Aluminum Panel, 6"x26"	4.50
1 ¼" Extension Shaft	.50

READY-TO-WIRE KIT, PRICE $90.15

POWER PACK—AUDIO AMPLIFIER and LC-28 UNIPAC

to operate in conjunction with the LC-28 Receiver—in Stock!!

COMPLETE KITS Magnaformer 9-8 CIRCUIT IN STOCK

NEW! HAMMARLUND ROBERTS HI-Q SIX

***Our New 1928 Catalog Is Now Ready.* Send For It NOW!**

THE PANEL FOR YOUR "LYNCH FIVE"

Here is an all-metal panel so carefully worked out that it will take almost any make of coil or condenser without the necessity of drilling additional holes. The panel itself is finished in a handsome brown crystalling lacquer and comes packed with Glodials, rheostat and brackets for mounting the sub-panel.

Known as the W. R. C. Universal Panel, it is truly universal in every sense. Actually nearly every make of instrument has been tried and found to fit properly in the insulated holes, and the experimenter will find an endless variety of combinations possible through its use. The W. R. C. Universal Panel is eminently adapted to the famous Lynch Five.

The WIRELESS RADIO Corp.
41 VARICK AVE.
BROOKLYN, N. Y. U. S. A.

CARTER

New "IMP" Power Switches

(for 110 Volt Circuit)

New "IMP" Automatic Power Switch

$1.50

Replaces relay. Controls any type of "A" or "B" supply. Switches off charger, "B" supply on, and closes filament circuit—3 operations in one.

New "IMP" Power Switch

New snap switch construction for 6 volt filament or 110 volt circuit. Complete with "ON" and "OFF" name plate.

75c

Any dealer can supply

In Canada: Carter Radio Co., Ltd., Toronto

Offices in principal cities of the world

MEMBER RMA

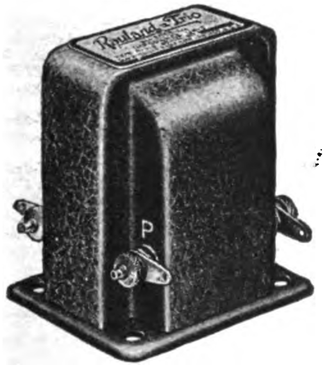
Carter Radio Co. CHICAGO

Every ALL-AMERICAN

TRADE MARK

Audio Unit *Guarantees* Natural Reproduction!

Rauland-Lyric Audio Transformer. Type R-500. Price.....$9.00



Rauland-Trio Impedance Unit. Type R-300, for Intermediate Stage, Price....$6.00 Type R-310, for Final Stage, Price............$6.00

Audio Transformer
Type R-14, 3 to 1 Ratio, $4.50
Type R-15, 5 to 1 Ratio, $4.50
Type R-13, 10 to 1 Ratio, $4.50

FINER radio reproduction than you have ever before experienced . . .

All those finer over-tones retained in their true and natural value, without muffle or distortion . . .

Smooth, flawless amplification . . . not a distorted note anywhere over the entire musical range . . . here is just what radio manufacturers and the public have been hoping to see developed!

All this is GUARANTEED by the makers of ALL-AMERICAN Audio Units.

These points of superiority have placed All-American in a position of leadership since 1919 . . . have made ALL-AMERICAN'S the largest selling transformers in the world.

ALL-AMERICAN Audio Units as shown here are the final refinement in radio manufacture. Any dealer, distributor or manufacturer will find it worthwhile to get the latest illustrated descriptive booklets—mailed free on request.

ALL-AMERICAN RADIO CORPORATION
4211 Belmont Avenue
Chicago, Ill.

The final improvement to be made in your set, install—

MODERN

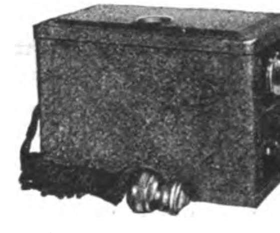
Type M Transformers

Regardless of how perfectly your set may be working, there is still finer reception in store for you. The performance of Modern Type M Transformers represents such an advance in audio amplification that they represent a new standard by which transformers may be judged. They combine high inductance, large core and wire sizes and perfectly proportioned windings. Impedances have been carefully matched to the units with which they must work.

The result is an almost flat performance curve with full response at 30 cycles and all over amplified high notes fully eliminated.

Satisfactory performance of Type M Transformers is guaranteed. Prices 1st and 2nd Stage, $8.50 each; Output $8.00; Push-Pull, $10.00 each.

Mail coupon below for blueprint folder showing Type M audio amplifying circuits.



MODERN

"B" Compact

A Raytheon "B" power unit that has been proven dependable and is guaranteed. Price $26.50 without tube. Sent by mail, postpaid, if your dealer cannot supply you.

The Modern Electric Mfg. Co.

Toledo, Ohio

Modern Elec. Mfg. Co., Toledo, Ohio
Please send prints of Type M audio circuits. I enclose 2c stamp.

Name ....

Address ....

City ....

PR-11

upon electron emission. It is, therefore, affected by those factors which affect impedance. Of course, the end of the life of a valve is usually determined by the limitation of the plate current by emission.

Another constant that affects the operation of vacuum valves in high-frequency amplifiers is the inter-electrode electrostatic capacity—that property which causes the signal to be passed directly through the valve, in this way partially short-circuiting it and weakening the signal. This is done by induction of current directly from filament to plate without control by the grid. As is well known, such an undesired feed-back voltage may cause the valve to set up oscillations which destroy its ability as an amplifier.

Many other factors, such as inter-electrode leakage and detector action, are too numerous or too complicated to discuss at length in this article. However, when a valve is tested for detector action sensitivity, one valve may sound louder than another on a strong signal, while on a weak signal the condition may be reversed.

A valve such as the UX-200-a type containing cæsium vapor that has atoms with electrons revolving much farther from the nucleus than is the case with the inert gas sometimes used in detector valves, is much more sensitive than one having inert gas.

The average grid-leak and condenser method of detection is obtained by adjusting the value of the leak resistance to give a proper range of grid potential. It has been shown by L. P. Smith, of the Research Laboratory, General Electric Company, that there are three main sources of distortion (1 and 2 result from the grid curvature characteristic): (1) frequency distortion due to harmonics; (2) amplitude distortion due to the fact that the rectified grid current varies as the square of the input voltage; (3) distortion due to the grid-leak and condenser.

There has also been developed the voltage regulator type of valve such as the UX-874, containing rare gases, carefully purified, and an alkali metal to furnish "starting" electrons. These valves will regulate and hold an almost constant voltage across their terminals over a wide range of current through them. Thus, the UX-874 will hold 90 volts at from 10 to 50 milliamperes load. They regulate by change in glow area.

There has not been space to mention all of the known and commonly used vacuum valve characteristics, or to discuss any one of them thoroughly. However, the data given above in brief form may serve to point out how many things must be taken into consideration, not only in the manufacture and testing of reliable vacuum valves, but also in their proper and most efficient use.

FREE

Simplified

BLUE PRINTS

You can have your choice of any one set of POPULAR RADIO Simplified Blueprints with your new or renewal subscription for POPULAR RADIO, accompanied by remittance of $3.00. These Blueprints will make it possible for you to build a tested and approved set. You, as a reader of POPULAR RADIO, know the many entertaining, interesting and instructive articles that are published each month. We promise that throughout the coming months POPULAR RADIO will hold more and more of interest for Radio Fans.

Ease, Economy and Accuracy in Construction

Simplified Blueprints make it possible for anyone, without previous knowledge of radio, to construct a highly efficient radio receiver. These Blueprints consist of 3 diagrams as follows:

Panel Pattern

This Blueprint is the EXACT size of the actual set. So accurate that you need merely lay it on your panel and drill as indicated. No scaling or measuring to do, no danger of ruining the panel through faulty calculation.

Instrument Layout

Here again you have an actual size print of each instrument and binding post and its exact location both on the panel and within the cabinet.

Wiring Diagram

The unusual feature of this Blueprint is that it is an actual size picture diagram of the finished set. Each instrument and other parts appear in exact size and the wires are so clearly traced from one contact to another that you can connect all terminals accurately without even knowing how to read a hook-up diagram.

Set No. 18—"*The Improved Raytheon Power-Pack*" (as described in the May, 1926, issue of POPULAR RADIO).
Set No. 22—"*The LC-27 Broadcast Receiver*" (as described in the October, 1926, issue of POPULAR RADIO).
Set No. 23—"*The LC-Senior Power-Pack*" (as described in the November, 1926, issue of POPULAR RADIO).
Set No. 24—"*The LC-Intermediate Power-Pack*" (as described in the December, 1926, issue of POPULAR RADIO).
Set No. 25—"*The LC-Junior Power-Pack*" (as described in the January, 1927, issue of POPULAR RADIO).

Use coupon below; indicate which set of Blueprints you want.

POPULAR RADIO
Dept. 49
119 West 57th Street New York City

POPULAR RADIO, Dept. 49
119 West 57th Street, New York City

Enclosed is my remittance of $...... in full payment for subscription, with Blueprints as checked below, FREE.

☐ **Set Number 18** ☐ **Set Number 23**
☐ **Set Number 22** ☐ **Set Number 24**
☐ **Set Number 25**

Name....................................

Street....................................

City.................... State..............

TRY IT 30 DAYS FREE

BEFORE YOU BUY

ALL METAL SHIELDED CHASSIS

8 tube~one dial

MIRACO

TRADE MARK REGISTERED

Only $\$69^{75}$

Retail List Completely Assembled

MAGNIFICENT TONE~SUPER SELECTIVE~POWERFUL DISTANCE GETTER

All Electric~or Battery Set!

Big Discounts to User-Agents

MIRACO Users Say:

Reports from users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof and testimony of nearby users.

CLEARER THAN A $450.00 SET

Before I bought your set I tried out and heard quite a number of different makes sets and I believe I can truthfully say that I never yet have heard a set with such wonderful tone and clearness as the Miraco. I never thought that a set could be as clear and reproduce tones and voices as the Miraco. Saturday I listened to a $450.00 set and it can't even come near your set for clearness and volume. I have logged some very distant stations on the Unitune and although people won't hardly believe me, the first week I had KFI Los Angeles on two nights in succession on a 30-ft. temporary inside aerial.—FRANK A. OLDENBURG, Milwaukee, Wis.

SHARPLY SEPARATES STATIONS

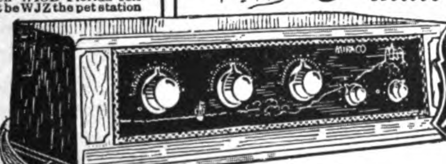
The Unitune brings in stations very clearly and with a selectivity that is amazing when you take in consideration the mass of stations on the air at the same time. I have heard three and four stations that were on almost same wavelengths at the same time and was able to tune out one after the other without the least interference.—W. L. BROBACK, San Francisco, Calif.

EXPERIENCED FAN PRAISES SET

Miraco is the most wonderful radio I have ever seen. I have had experience with many popular makes of radios, also have built a number of them myself but in tone quality it is far superior to all. For sensitiveness I can say it is more like a superhetrodyne.—R. D. WHITE, Proctor, W. Va.

HAS POWER TO SPARE

"Well Pleased" with Miraco would be putting it mildly. Haven't heard anything to equal it regardless of price. With temporary aerial tuned in WEAF then WIOD Florida felt sure this must be WJZ the pet station of this locality. Stations all coming in clear with wonderful tone and tremendous volume. Seldom have more than half of volume turned on. A local agent insisted he could prove his set superior but to his surprise and astonishment my family and neighbors and the agent himself admitted his $165 set had to step out of the way for Miraco—H. W. HOEPFL, Perkiomensville, Pa.



6 tube Super $\$36^{75}$ RETAIL LIST

Another Big Bargain! Famous powerful big Miraco Super 6, 1928 model—ultra selective! Thousands find it outperforms sets of much higher price. **30 Days' Trial Free. Fully Guaranteed.**

America's big, old, reliable Radio Corporation* (8th successful year) **guarantees** in its big, powerful, latest 6, 7 and 8 tube Miraco sets "the finest, most enjoyable performance obtainable in **high grade** radios." Unless 30 days' use in your home fully satisfies you a Miraco is unbeatable at any price for beautiful, clear cathedral tone, razor-edge selectivity, powerful distance reception, easy operation, etc.—**don't buy it! Your verdict final.** Save or make lots of money on sets and equipment—write for testimony of nearby users and **Amazing Special Factory Offer.**

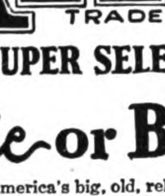
Miraco's work equally fine on "AC" electric house current or with batteries. Take your choice. Many thousands of Miraco users—who bought after thorough comparisons—enjoy programs Coast to Coast, Canada to Mexico, loud and clear—with the magnificent cathedral tone quality of costliest sets. Don't confuse Miraco's with cheap, "squawky" radios. Miraco's have finest parts, latest approved shielding, metal chassis, etc.—as used in many $200 sets.

Deal Direct with Big Factory

Your Miraco reaches you completely assembled, rigidly tested, fully guaranteed. Easy to connect and operate. **30 days' trial free.** 3 year guarantee if you buy. You take no risk, you insure satisfaction, you enjoy **rock-bottom money-saving prices** by dealing direct with one of radio's oldest, most successful builders of fine sets. 8th successful year in the radio manufacturing business.

USER-AGENTS! Make big profits showing Miraco to friends. Get Our Special Wholesale Prices!
***MIDWEST RADIO CORPORATION, Cincinnati, O.**

Dealers Write!

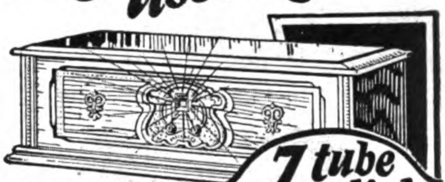


Free!

BEAUTIFULLY ILLUSTRATED CATALOG AND AMAZING SPECIAL OFFER

SEND NO MONEY—30 DAYS' TRIAL, Special Wholesale Price Offer to User-Agents, Bank References, testimony of nearby Miraco users —*all the proof you want*—sent with catalog.

mail coupon right now!



MIRACO "Powerplus" sets—both in 8 and 7 tube models—have magnificently beautiful, clear cathedral tone quality. Turn one dial for stations everywhere. Ultra-selective. Miraco multistage distance amplification gives "power-plus" on far-off stations. Latest all-metal shielded chassis. Illuminated dial. Fully guaranteed. *Try one free for 30 days!* Choice of beautiful cabinets.

7 tube one dial
METAL SHIELDED CHASSIS
$\$49^{75}$
RETAIL LIST

Electrify Any Radio *with* MIDWEST NO-BATTERY "AC" Light Socket Power Units

BIG DISCOUNT TO User-Agent

"A", "B" and "C" power, direct from light socket, without batteries! Write for Midwest prices and discounts. Midwest Units are highest grade—lastingly dependable, quiet in operation, fully guaranteed.

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
479 E Miraco Building, Cincinnati, Ohio.

THIS COUPON IS NOT AN ORDER

Without obligation, send free catalog, AMAZING SPECIAL OFFER, testimony of nearby Miraco users. ☐ User ☐ Agent ☐ Dealer

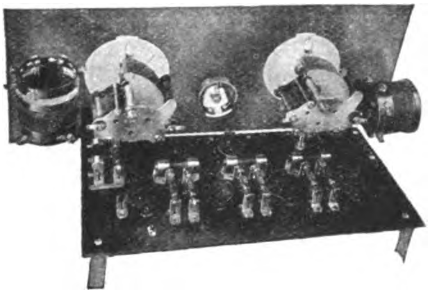
NAME

ADDRESS

LYNCH

Improved Aristocrat

5 tube de luxe Deck



New and Different

Here is an example of a real receiver made with the Lynch 5 tube De Luxe Deck. This is one model of the Improved Aristocrat—The list price for all the parts necessary is less than $30.00.

For Use in Building any 5-Tube Receiver

The Deck includes, all mounted ready for wiring

- 1 Westinghouse 6" x 12" Micarta Panel
- 5 Eby De Luxe Sockets
- 4 Lynch Cartridge Condensers
- 7 Lynch Metalized Resistors
- 4 Lynch Special Mounts

The Deck is a Lynch innovation which greatly reduces the cost; improves the appearance and performance and simplifies home construction beyond belief.

The Lynch 5-Tube Deck

$12.50

and Now

The LYNCH BOOK

Just off the Press

"Resistance the Control Valves of Radio"

A very thorough treatise on the proper use of resistors of every type for every radio purpose. Many pages—Many illustrations—Many dollars worth of sound information for a quarter.

Send your quarter and we'll send the book today

ARTHUR H. LYNCH, Inc.
General Motors Building
New York City
Sales Offices in Most Large Cities

WITH THE EXPERIMENTERS

CONDUCTED BY S. GORDON TAYLOR

Hints on the Pre-Selector

(*This device improves the selectivity of any standard receiver. Complete constructional data were given in the May, 1927, issue of* POPULAR RADIO.)

THE Pre-selector has been under test for a period of several months now with numerous types of commercial and home-made receivers, and so far not a single receiver has been found that was not made more selective through its use. There have been a few receivers which experienced a loss in efficiency when used with the Pre-selector, but these few exceptions were either superheterodynes or old-fashioned regenerative receivers that employed no high-frequency amplification other than that obtained through the use of regeneration in the detector.

The letters received from readers so far indicate only one source of trouble in the Pre-selector—the failure of the oscillator to function. This may result from the use of a defective UX-199 valve in the left-hand socket, or to poor contacts between the left-hand coil and its socket.

It is a simple matter to test out the Pre-selector to determine whether or not its two circuits are functioning properly.

The frequency changer (detector) circuit is tested by connecting the Pre-selector to the "A" and "B" batteries, the antenna and the ground in the usual way, but with a pair of headphones connected between the 45-volt tap of the "B" battery and the "B+" terminal of the Pre-selector. The output binding post of the Pre-selector is left unconnected. Thus arranged, the frequency changer valve will function as a single-valve receiver and signals will be audible in the headphones. Tuning in this case is accomplished by means of the right-hand dial alone. During this test the left-hand valve (oscillator) may be either in or out of its socket, as it does not play any part in the test. Both coils must be in their sockets, however.

To test the oscillator circuit the Pre-selector should be placed 3 or 4 feet from the regular receiver and should be connected to the "A" and "B" batteries, but not to the receiver or to the antenna. The receiver should be connected up in the regular manner, and some broadcasting station with a wavelength of 250 meters or lower should be tuned in. Then the left-hand dial of the Pre-selector should be slowly rotated. If the oscillator is functioning, a "birdie" whistle will be heard in the reproducer when the oscillator is tuned past the same frequency as the receiver.

If no heterodyne whistle is heard, try switching the valves in the Pre-selector. Perhaps the one in the left-hand socket is incapable of oscillating, but the one used in the frequency changer socket may be good for this purpose. If there is still no whistle in the reproducer, then it is likely that there is a poor connection somewhere in the oscillator circuit.

If these two tests are made and show the two circuits to be functioning, there should be no difficulty when the Pre-selector is connected between the antenna and the receiver.

Literature for the Experimenter

MANY experimenters may not be aware that there is a wealth of good radio literature available to anyone who asks for it. The costs are usually nominal.

Many of the larger radio manufacturers publish pamphlets that contain much helpful discussion of the various principles and practices involved in radio. Some of the low-frequency amplifier parts manufacturers, for instance, offer booklets which go into considerable detail regarding the theory of low-frequency amplification, and discuss the relative merits of various types of coupling for such amplifiers. Many of these booklets give hook-ups and design data, and suggest various uses for the instruments and parts involved.

It is well worth while for any experimenter to take advantage of the offers of these manufacturers, which may usually be found by consulting the advertising columns of POPULAR RADIO.

—DAVID LAY

All Electric Radio

The Randolph

7 Tubes-*Single Control*

JUST plug this Randolph Radio into the electric light socket—and tune in. A powerful, selective radio that gives dependable coast to coast reception. **No batteries, chargers, eliminators, acids or liquids.** Here is complete radio satisfaction whenever you want it. The easy tuning with one control brings on all stations. Illuminated drum allows you to operate the radio in the dark and has space for logging stations. Every detail of the Randolph is modern and perfected—it is the utmost in radio—unsurpassed regardless of price. It is this wonderful radio that you test and try for 30 days FREE before you buy. Listen to it in your own home. When it convinces you by actual performance it is the ideal radio—the one you have always hoped for—**you can buy it direct at factory prices.** Be sure you write for free descriptive literature today.

30 DAYS FREE TRIAL

6 Tube $55 Retail Price

Biggest Discounts To Agents

Beautiful Ampliphonic Console

Illustrated here is one of the beautiful Randolph Seven Console Models—made of the finest carefully selected heavy solid walnut, hand-rubbed and with burl finish. Has built-in genuine large cone speaker that compares with any on the market. Assures unlimited reception of high notes and low notes clear as a bell. Completely electric—**uses no batteries of any kind.** Be sure you send for fully illustrated, full color folder giving complete details.

Genuine Walnut Cabinets

The finest of heavy, genuine, solid burl finish walnut is used in the making of all Randolph cabinets. No picture can do them justice. You must see them to appreciate them.

6-Tube Radio

New, modern, single-control, six-tube radio. Do not compare this set with old-style, 2-dial, 6-tube sets selling for about the same price. The Randolph 1928 Senior Six has also been tested and approved by the leading radio engineers. Comes in beautiful solid walnut cabinet of hand-rubbed finish. Single control. Illuminated drum with space for logging. Absolutely dependable and very selective. **Send for 30 days free trial. You test it before you buy.**

All Sets Guaranteed

Biggest Discounts to Agents

Work either full or part time and make big money. Sensationally big discounts to agents. No experience required. Randolph All-Electric Sets sell on first demonstration. Tremendous advertising campaign helps you. Men and women both make big money this way. Demonstrating set sent on 30 Days TRIAL. WRITE NOW for proposition.

RANDOLPH RADIO CORPORATION
711 West Lake Street Dept. 317 Chicago, Ill.

USE THIS COUPON TODAY!

Randolph Radio Corporation
711 West Lake Street, Dept. 317
Chicago, Illinois

Send me full particulars about the RANDOLPH Six and Seven-Tube Electric and Battery Table and Console Sets with details of your **30 Day FREE Trial Offer.**

Name...

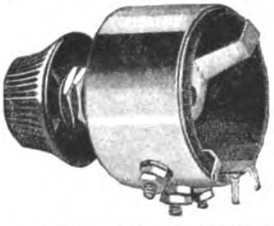
Address...

City.................................State.................................

Mark here ☐ if interested in Agent's proposition.

Improved Positive VOLTAGE CONTROL for "B" Eliminators

HEAVY DUTY Centralab PotentiometeR

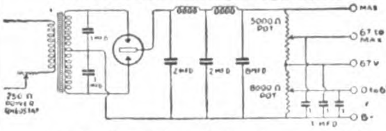


A new Centralab variable resistance that is all wire-wound and has exceptionally heavy current carrying capacity. Units are practically heat-proof and will dissipate up to 20 watts through entire resistance without danger of burning out. This new unit has great advantages for regulating the output of "B" eliminators. A single turn of the knob gives full resistance variation with the resistance remaining constant at any knob setting so that the knob or panel can be calibrated in volts.

Has sufficient current-carrying capacity to permit shunting a low resistance value directly across the "B" power output. This assures a constant current load sufficiently high to reduce the output voltage of the rectifier to workable pressure even though the set is not connected. By preventing the extremely high no load voltage, it serves to protect the filter condensers from break down—the most common source of trouble in "B" eliminators.

Centralab Potentiometer control also provides much better voltage regulation than can be obtained with series resistors. Any change in current at the set will produce a very small change in the voltage at the taps. This factor couples with the non-inductive of Centralab Heavy Duty Potentiometers, insures best tone quality with a minimum of by pass condensers.

"B" Power Circuit for Best Possible Voltage Regulation



This circuit is suitable for any "B" power with an output of 200 volts or less. The resistances are Centralab Heavy Duty Potentiometers HP-005 and HP-008 and Power Rheostat PR-250.

Centralab Heavy Duty Potentiometer may be used as straight variable resistances by connecting the center terminal and one outside terminal. They may be used to replace resistances on old eliminators as well as in building new ones. The diameter is 1⅝ inches.

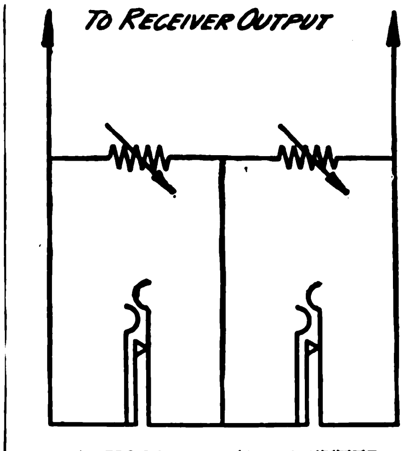
Because of their heavy current carrying capacity, Centralab Heavy Duty Potentiometers are adaptable to transmitter work of Amateurs as Variable Grid Leak resistances, filament voltage dividers and various positions in receiver circuits.

Resistances—2,000, 3,000, 5,000, 8,000, 10,000, 15,000, 20,000, 50,000. Price, $2.00.

At your dealer's, or C. O. D. Write for new folder "Resistances and Their Function in Radio Circuits."

CENTRAL RADIO LABORATORIES
17 Keefe Ave. Milwaukee, Wis.

Centralab CRL



A HOOK-UP FOR BETTER REPRODUCTION

FIGURE 1: *By hooking up in series two reproducers, one of which covers the lower audible frequencies well and the other the higher, a blended output of excellent quality may be obtained.*

Better Reproduction Through the Use of Two Reproducers

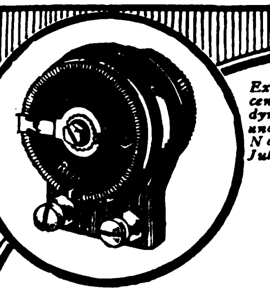
MANY critical radio fans have found that by using a combination of two reproducers, connected in series, more realistic reproduction can be obtained. A combination of a horn reproducer with a cone reproducer will frequently give results far superior to those obtained with either reproducer alone. This improvement is particularly pronounced when one of the reproducers has a decided tendency to favor the medium and low notes and the other inclines toward the higher notes.

A further refinement can be obtained by using this arrangement, but with each of the reproducers shunted by a variable high resistance so that the volume of each of the reproducers can be individually adjusted to provide just the proper blend.

Figure 1 shows a schematic arrangement to facilitate these connections. With this arrangement the two reproducers may be used together by inserting their plugs into the two jacks, or either may be used alone by inserting its plug into one of the jacks. In the latter case the other jack maintains a closed circuit and at the same time short-circuits the unused resistance unit. The jacks should be of the single circuit, closed type, and the resistances should be variable from approximately zero to several megohms for best results.

Why Are Radio Receivers Shielded?

FEW elements of radio construction are so commonly misunderstood as the shielding of a receiver. Shielding is the subject of widely varying views, ranging from the claim that it is absolutely essential, to a statement by some makers that shielding is only a clumsy com-



Exclusively Licensed by Technidyne Corporation under U.S. Patent No. 1593658, July 27, 1926.

The Expert's Choice

ROYALTY VARIABLE HIGH RESISTANCES

Reception from your radio depends upon the quality and efficiency of even its smallest parts. That's why fans everywhere insist on Electrad Royalty wherever variable high resistances are required.

Electrad Royalty Resistances are acknowledged superior because (1) Same resistance always secured at same point, (2) contact made positive by metallic arm on wire-wound strip, (3) resistance element not exposed to mechanical wear.

A range for every purpose—11 in all, designated A to L. Type E, $2.00. All other types, $1.50.

Write for hook-up circular

175 Varick Street Dept. 59B New York, N. Y.

ELECTRAD Inc

Statement of the ownership, management, circulation, etc., required by the act of Congress of August 24, 1912, of POPULAR RADIO, published monthly at New York, N. Y., for October 1st, 1927, State of New York, County of New York.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Douglas H. Cooke, who, having been duly sworn according to law, deposes and says that he is the Publisher of the POPULAR RADIO and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Douglas H. Cooke, 119 West 57th Street, New York City, N. Y.; Editor, Raymond F. Yates, 119 West 57th Street, New York City, N. Y.; Managing Editor, Raymond F. Yates, 119 West 57th Street, New York City, N. Y.; Business Manager, E. A. Harm, 119 West 57th Street, New York City, N. Y. 2. That the owner is: POPULAR RADIO, Inc., whose stockholders are: Douglas H. Cooke, 119 West 57th Street, New York City, N. Y.; Laurence M. Cockaday, 119 West 57th Street, New York City, N. Y.; Theodora W. Cooke, 59 Beechmont Drive, New Rochelle, N. Y.; Charles C. Moore, 345 Madison Ave. New York City, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: NONE. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. Douglas H. Cooke, Publisher. Sworn to and subscribed before me this 20th day of September, 1927. Gerard J. Traub, Notary Public, Queens County. (My commission expires March 30. (1929.

FREE!

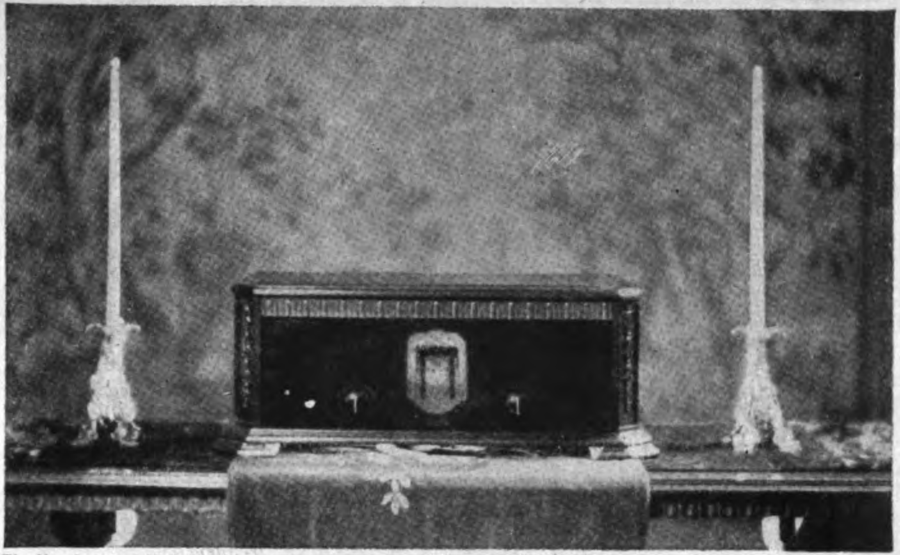
Back Copies of Popular Radio

FOR the convenience of those readers of POPULAR RADIO who have been so unfortunate as to have missed the issues describing such remarkable receivers as the LC-28 and the Magnaformer Superheterodyne, the Subscription Department has made it possible to obtain these important numbers without cost. The articles describing the theory and construction of these receivers began in the September number. This, together with the October number, will be sent free to all those who subscribe during the coming month. This makes it possible to obtain fourteen issues of POPULAR RADIO for the price of twelve.

The subscription price of POPULAR RADIO is $3.00 per year.

Subscription Department

POPULAR RADIO, Inc.
119 W. 57th St., New York City



The New Improved Hi-Q Six—the creation of ten foremost American Radio Engineers—a receiver far in advance of its time

Exclusively CUSTOM-BUILT

From Our Simple Instructions
and at Great Savings!

NO *ordinary* standards can be applied to this latest improved Hammarlund-Roberts Receiver, for it is the result of a determination to produce America's very finest instrument—*absolutely regardless of cost!*

Every modern constructional feature has been incorporated. Each part is the most efficient known to radio science, and the entire group has been purposely selected for perfect synchronization.

Complete isolation of four tuned circuits plus Automatic Variable Coupling effects maximum and uniform amplification over the entire wave band. Distortion is totally eliminated. Oscillation is utterly absent. Symphonic transformers and a power tube faithfully reproduce the full musical scale. Selectivity, even in crowded areas is something to marvel at. *And tonal quality simply MUST be heard to be appreciated!*

Such a set, factory made, and sold through usual channels, would cost $250.00 to $300.00, but through following our simple instructions you can purchase all parts for only $95.80 (less cabinet) and build this supreme receiver yourself a CUSTOM-BUILT set which gives you CUSTOM-BUILT results at a saving of $100 to $150.

Completely drilled panel and sub-panel are foundation for easy building.

Get the complete Hi-Q Instruction Book from your dealer — or write us direct. Price 25 cents.

Hammarlund ROBERTS Hi-Q SIX

HAMMARLUND-ROBERTS, Inc. 1182-B Broadway, New York City

Associate Manufacturers

Radio Is MUSIC with

Build It Yourself in 30 Minutes

COMPLETE KIT, $12.00

ENGINEERS have proved mathematically the superiority of the three-foot cone speaker. Radio fans all over America praise the FENCO, the double-cone speaker of superb quality.

The FENCO Kit contains everything you need to build a radio speaker that is equal to any $60 speaker you ever heard.

Finest quality of materials. Easy to assemble. Satisfaction guaranteed or money refunded.

Send check or money order for $12 today to

FENCO CONE COMPANY
57 Murray St., New York, N. Y.

The **Three-Foot FENCO DOUBLE CONE**

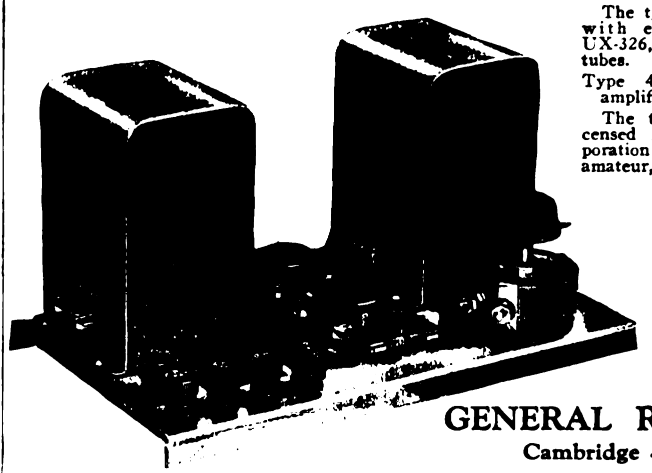
The GENERAL RADIO
TYPE 441
Push-Pull Amplifier

In a search for an amplifier combination which would give the maximum in quality and volume, the push-pull method has proved particularly satisfactory.

While push-pull transformer coupling does not increase the amplification per stage, the maximum undistorted power output is greatly increased. The reason for this is that distortion due to tube overloading cancels out, permitting a greater output from each tube than would be possible if the tubes were used as in other methods of coupling. A further advantage of push-pull amplification when using an A. C. filament supply is that hum voltages also cancel out, rendering the amplifier very quiet.

The type 441 unit with two type 171 power tubes having a plate voltage of 180 will give more volume and better quality than a single transformer coupled stage using the type 210 power tube with 400 volts on the plate.

The General Radio Type 441 unit is completely wired and mounted (as illustrated) on a brass base-board with conveniently located binding posts so that the unit may be built into a receiver or connected with an existing set as a separate unit.



The type 441 may be used with either the UX-226, UX-326, or UX-171, CX-371 tubes.

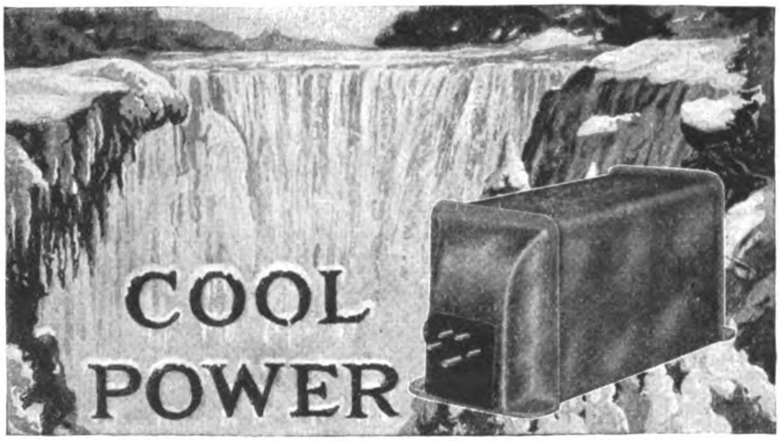
Type 441 Push-pull amplifier $20.00

The type 441 unit is licensed by the Radio Corporation of America for radio amateur, experimental, and broadcast reception only, and under the terms of the R. C. A. license the unit may be sold only with tubes.

Type UX-226 or CX-326 Amplifier Tube..$3.00

Type UX-171 or CX-371 Amplifier Tube. 4.50

GENERAL RADIO CO.
Cambridge - - - Mass.



SAMSON POWER BLOCK NO. 210
The only block which will supply 500 volts at 80 mils to two 210 tubes

Powerize with Samson Units for Best Results

For new SAMSON Power Units insure the best there is in radio current supply by

1. Doing away with hum, motor boating and poor voltage regulation.
2. Remaining so cool after 24 hours continuous operation under full load that they will be well within the 20° rise of temperature specified by the A. I. E. E.
3. Being designed to more than meet the specifications adopted by the National Board of Fire Underwriters.
4. Insuring safety against shock because of protected input and output terminals.
5. Insuring for all tubes the correct filament voltages specified by their manufacturers.
6. Compensating for lighting circuit voltage variation by the use of a special input plug and terminal block to which is attached a 6 ft. flexible rubber-covered connecting cord and plug.

Our Power Units bulletin descriptive of these is free for the asking. In addition, our construction bulletin on many different "B" Eliminators and Power Amplifiers will be sent upon receipt of ten cents in stamps to cover the mailing cost.

SAMSON ELECTRIC COMPANY
Manufacturers
Since 1882
Principal Office:
Canton, Mass.

promise to offset faulty circuit design.

There are two important functions of metal shielding: First, to assist in cutting out undesired local stations and neighboring sources of interference; second, to isolate the high-frequency stages in order that electromagnetic coupling may be eliminated. The efficient performance of these duties usually requires that shield be free from openings of any magnitude.

In receivers of high amplification, the detector tube must be even more heavily guarded, since the detector is essentially an output device, which might otherwise send undesirable impulses along to the reproducer. This extra protection may be obtained through the use of an output filter in the detector circuit. Such a device permits only the useful portion of the detector output to reach the amplifier.

Thorough shielding affords a further advantage in that it permits insertion of tuning coils in closer proximity to each other and with parallel axes, thus conserving considerable space. Without shielding, the coils must be spaced further apart, and with their axes at difficult angles.

The other important function of shielding is to aid in the elimination of undesirable local signals. Receivers without scientific metal covering contain so many exposed wires and metal parts that direct pick-up of strong local signals is almost unavoidable. Shielding, however, confines all pick-up to the aerial, and places all responsibility for foreign signals upon the tuning devices. If the receiver tunes sharply enough to select the proper impulse from the aerial, local interference need never be feared.

—K. L. Henderson

A Handy Transformer Rule

Nowadays, when so many radio experimenters are constructing small power transformers to aid them in their work, they often find it necessary to figure the proper number of primary turns. Many of them are reduced, in order to find this number, to going through a very complicated formula. But, since such transformers are almost invariably designed for 110-volt, 60-cycle circuits, and for use with a core of silicon steel, it is possible to simplify the usual formula to the following:

Divide 835 by the cross-sectional area of the core in square inches, and you have the required number of primary turns. Simple, isn't it? The rule was obtained by substituting in the well-known formula:

$$N_p = \frac{F \times 10^8}{4.4fAB}$$

This assumes an economical flux density of 50,000 lines per square inch. This will be found correct for the average quality transformer iron.

—Charles D. Savage

Your "B" Battery Eliminator will give you better service with

Q·R·S

(Trade Mark Registered)

Gaseous Rectifier Tubes

ARE BETTER

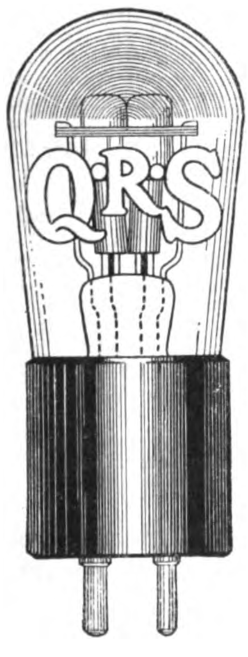
60 Milliamperes - $4.50
85 Milliamperes - 4.50
400 Milliamperes - 7.00

Ask for Catalog of full line of Standard Tubes.

Guaranteed

The standing of the Q·R·S Company, manufacturers of quality merchandise for over a quarter of a century, establishes your safety.

Orders placed by the leading Eliminator Manufacturers for this season's delivery, approximating Four Million Dollars' worth of Q·R·S Rectifier Tubes, establishes the approval of Radio Engineers. Ask any good dealer.



THE Q·R·S COMPANY
MUSIC

Manufacturers

Executive Offices: 306 S. Wabash Ave., Chicago

Factories: Chicago—New York—San Francisco—Toronto, Canada—Sydney, Australia—Utrecht, Holland

Established 1900. References—Dun, Bradstreet, or any bank anywhere

Google

CeCo Tubes are Specified for the Lynch Five Receiver

DESCRIBED IN THIS ISSUE

Special Tubes for Particular Radio Functions

Besides General Purpose Tubes, CeCo produces Special Purpose Tubes, Power Tubes, Filament Type Rectifiers, Gas Filled Rectifiers and A. C. Tubes.

Each is Perfect for its purpose; tested to highest standards, critically inspected, evacuated by an exclusive process that assures longer life.

Ask your Radio Dealer for Complete Data Sheet of CeCo

C. E. MFG. CO., Inc., PROVIDENCE, R. I., U. S. A.

CeCo RADIO TUBES

SEND FOR FREE CATALOG

from

Chicago's Oldest Radio Jobbers

and See What You Save!

GREATER BETTER VALUES

New Kits Featured Include:
Aero, Bodine, Camfield, Citizens, H-F-L Infradyne, Karas, Melo-Heald, Scott's, Silver-Marshall, St. James, Tyrman, etc.

Everything new and desired—all under one roof. You don't need to look elsewhere. Complete stock carried.

TELMACO

Prompt Dependable
Efficient Service

Telephone Maintenance Co.
123-O South Wells Street
Chicago, Illinois
Established in 1918

WHOLESALE ONLY!

CHICAGO'S OLDEST RADIO HOUSE

My Adventures With Radio Operators

HERE is a protest against capitalistic control that comes from an observant young lady in Vassar College who has apparently had experience in sending radiograms and telegrams. Perhaps some radio operator can answer her:

Just what explanation is there for the utterly blank expressions on the faces of radio and telegraph operators when they read your message?

By long and tedious calculations I reduced the explanation to three possibilities:

1. Operators are physically incapable of showing any expression;
2. The messages do not cause them to do so;
3. There is a professional ruling against it.

The first possibility was soon discarded, for by visiting one hundred and one representative radio and telegraph offices in seventeen different states I found eighty-nine operators who, when not actually reading messages, showed a natural facial appearance. These observations were made at different seasons of the year and at varying times of day to avoid error due to local circumstance.

Then came my more laborous task. I succeeded in classifying messages which might reasonably be expected to cause some play of the facial muscles into three groups; the tragic, the humorous and the startling. I composed several messages of each type and sent them, in progressive rotation, from each of the stations under observation to my friends here and abroad. I would submit first a tragic message, for instance:

"Grandfather broke five ribs falling from merry-go-round. Had five unused tickets."

Later I would send a message of the second class, such as a catchy riddle and answer, a humorous little verse or a sparkling quotation from the classics.

Finally, I would submit the third type, such as:

"Have planted the bomb. Tell Maisie to leave Woolworth Building by Friday noon."

In each case I carefully observed the face of the operator while he read. Of the three hundred and three experiments thus made, *not one* subject changed expression, nor so much as broke the rhythm of his gum-chewing.

I am, therefore, forced to accept the truth of my third possibility. There must be some secret regulation that forbids to all these splendid young men the right to a normal expression of emotion.

This is carrying capitalistic control too far. What are we, as one hundred per cent Americans, going to do about it?

—ALICE A. PECK

* *

Snap Shots

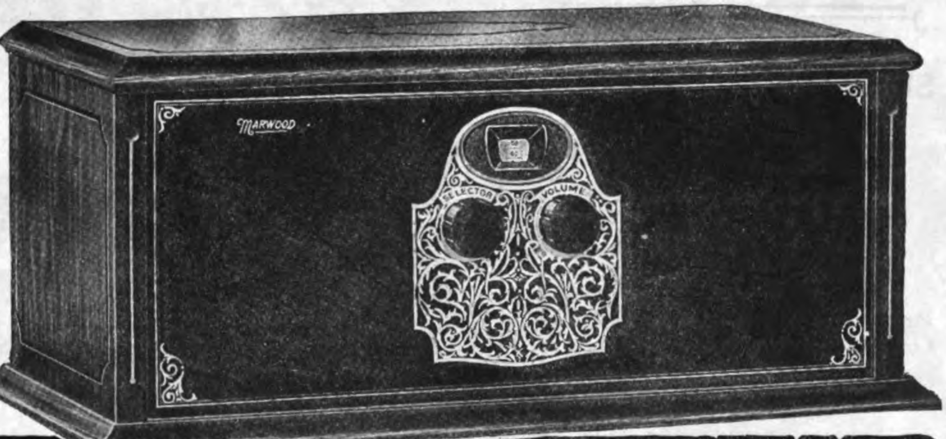
PITY the poor radio announcer. While the rest of the crowd are climbing over the seats to join the snake dance he has to stay in his coop and tell the baseball world what is going on.

* *

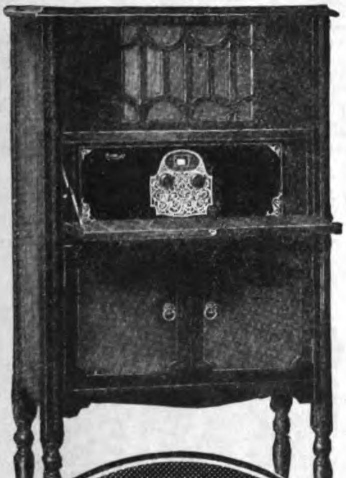
SOMEBODY is always taking the joy out of life. The short waves now used by amateurs carry as well in the daytime as at night and there is no longer any excuse for staying up till morning.

30 Days FREE TRIAL 5 Year Guarantee

MARWOOD



The 1928 Sensations! 8 Tube-1 Control



All Electric
or Battery Operation

AGAIN Marwood is a year ahead—with the Radio sensation of 1928—at a low price that smashes Radio profiteering. Here's the sensation they're all talking about—the marvelous 8 Tube Single Control Marwood for BATTERY or ALL ELECTRIC operation. Direct from the factory for only $69.00 retail price—a price far below that of smaller, less powerful Radios. Big discount to Agents from this price. You can't beat this wonderful new Marwood and you can't touch this low price. Why pay more for less quality? To prove that Marwood can't be beat we let you use it on 30 Days' Free Trial in your own home. Test it in every way. Compare it with any Radio for tone, quality, volume, distance, selectivity, beauty. If you don't say that it is a wonder, return it to us. We take the risk.

Only $69 RETAIL PRICE Big Discount to Agents From This Price

New Exclusive Features

Do you want coast to coast with volume enough to fill a theatre? Do you want amazing distance that only super-power Radios like the Marwood 8 can get? Do you want ultra-selectivity to cut out interference? Then you must test this Marwood on 30 Days' Free Trial. An amazing surprise awaits you. A flip of your finger makes it ultra-selective—or broad—just as you want it. Every Marwood is perfectly BALANCED—a real laboratory job. Its simple one dial control gets ALL the stations on the wave band with ease. A beautiful, guaranteed, super-efficient Radio in handsome walnut cabinets and consoles. A radio really worth double our low price.

ALL ELECTRIC 8 Tube 1 Control $98 RETAIL PRICE

Buy From Factory—Save Half

Why pay profits to several middlemen? A Marwood in any retail store would cost practically three times our low direct-from-the-factory price. Our policy is highest quality plus small profit and enormous sales. You get the benefit. Marwood is a pioneer, responsible Radio, with a good reputation to guard. We insist on the best—and we charge the least. If you want next year's improvements NOW—you must get a Marwood—the Radio that's a year ahead.

Get Our Discounts
Before You Buy a Radio

Don't buy any Radio 'till you get our big discounts and catalog. Save half and get a Radio that IS a Radio. Try any Marwood on 30 Days' Free Trial at our risk. Tune in coast to coast on loud speaker with enormous volume, clear as a bell. Let your wife and children operate it. Compare it with any Radio regardless of price. If you don't get the surprise of your life, return it. We take the risk. Don't let Marwood low prices lead you to believe Marwood is not the highest quality. We have smashed Radio prices. You save half.

6 Tube—1 Control

This is the Marwood 6 Tube, 1 Control for BATTERY or ALL ELECTRIC operation. Gets coast to coast on loud speaker with great volume. Only $47.00 retail. Big discounts to Agents. Comes in handsome walnut cabinets and consoles. This low price cannot be equalled by any other high grade 6 tube Radio. Has the volume of any 7 tube set. If you want a 6 tube Radio you can't beat a Marwood and you can't touch our low price.

$47 RETAIL PRICE Big Discount to Agents f

Big Discount to Agents From this Price

Has Complete A-B Power Unit

A REAL ALL ELECTRIC Radio with one of the best A-B power units on the market—no batteries needed—at the world's lowest price. This Marwood can't be excelled at ANY price. If you have electricity in your home, just plug into the light socket and forget batteries. No more battery trouble and expense. Costs less than 2c a day to operate. Always have 100% volume. ALL ELECTRIC Radios are high priced because they are new. We cut profits to the bone and offer a $250.00 outfit for $98.00 retail price. Big discount to Agents. Don't buy any Radio 'till you get details of this sensational new ALL ELECTRIC Marwood.

AGENTS
Make Big Spare Time Money

Get your own Radio at wholesale price. It's easy to get orders for the Marwood from your friends and neighbors. Folks buy quick when they compare Marwood quality and low prices. We want local agents and dealers in each territory to handle the enormous business created by our national advertising. Make $100 a week or more in spare time demonstrating at home. No experience or capita needed. We show you how. This is the biggest season in Radio history. Everybody want a Radio. Get in now. Rush coupon for 3 Days' Free Trial, beautiful catalog, Agents Confidential Prices and Agents' New Plan.

MARWOOD RADIO CORP.
5315 Ravenswood Avenue
Department B-2, Chicago, Illinois

SEND TO

PRECISION

FOR YOUR

LC-28 KIT

Precision Coils are in the LC-28! Mr. Cockaday likes our Coils — you'll like our kits and service. Parts exactly as specified by Mr. Cockaday.

4 Hammarlund Mid-line Variable Condensers, .000275 mfd. @ $5.10		$20.40
1 Hammarlund double drum dial		6.00
4 Precision type 4-B radio frequency transformers		12.50
3 Samson high frequency chokes, type No. 125 @ $2.25		6.75
1 Samson high frequency choke, type No. 85		2.00
3 Aerovox Moulded Condensers, .02 mfd. @ $1.50		4.50
1 Aerovox Moulded Condenser, .00025 mfd		.35
1 Aerovox Moulded Condenser, .00075 mfd.		.40
1 Yaxley combination switch and rheostat, 6 ohms, No. 906-K		1.75
1 Yaxley cable connector plug with cable, type 660		3.00
4 Carter fixed resistances, 4 ohms, type H-4 @ .25		1.00
2 Carter No. 10 tip jacks, @ 10c. each	$.20	
1 set insulating washers for tip jack	.05	
2 "Imp" plugs cord tip type @ 15c. each	.30	.65
1 Antenna name plate	.05	
1 Ground name plate	.05	
4 Benjamin vibrationless sockets @.75		3.00
1 Lynch single resistance mounting		.35
1 Lynch Suppressor, 500 ohms		1.50
1 Lynch Suppressor, 600 ohms		1.50
1 Lynch Suppressor, 700 ohms		1.50
1 Durham Metallized resistor, 6 megohms		.50
2 Tait brackets		2.00
1 Alcoa aluminum chassis		7.50
4 Sets special aluminum box shields for LC-28 @ $2.00		8.00
1 Aluminum panel, 6-in. by 26-in.		4.50
1⅛-in. extension shaft		.50
TOTAL		$90.15

Type 4D

The New *Diamond Cut*

PRECISION COILS

are now the

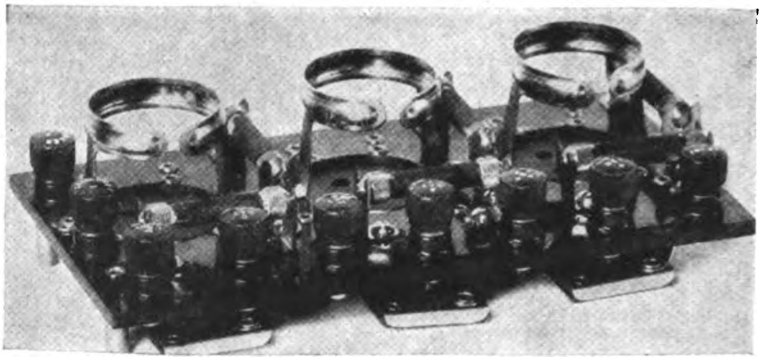
"Standard of Comparison"

They are accurate to within 1% of the rated inductance and most of them are better. Only with diamonds can this extreme accuracy be obtained. The *diamond cut* bakelite assures accurate spacing of the turns and uniform diameter of the tubing. Our new catalogue gives more details. Send for it.

Coils shown are our Type
F. Choke

What's New in Radio

(*Continued from page 341*)



A Compact Amplifier Kit

Name of instrument: Resistance-coupled amplifier.

Description: This unit contains three stages of resistance-coupled amplification including the brackets for mounting the resistance, the resistances themselves and the necessary coupling condensers. The whole outfit is mounted on a bakelite strip that contains, as an integral part, the three vacuum-tube sockets. It is further equipped with the necessary binding-posts for the "A," "B" and "C" batteries and the input and output terminals. The whole unit may be incorporated in a receiver that is being built by the experimenter.

Usage: In a radio receiving set as a complete amplifier.

Outstanding features: Compact amplifier arrangement. Neat workmanship, easy to install.

Maker: Heath Radio & Elec. Mfg. Co.

A Valve That Operates on Dry Cells

Name of valve: DV-3a.

Description: This valve has the same operating characteristics as the DL-3 valve. The only difference between the two lies in their physical shape and their bases. The DV-3a has an old-style UV-199 type base and is for use with the old-style 199 sockets.

This is also a dry-cell valve and has the same filament requirements as the DL-3 valve.

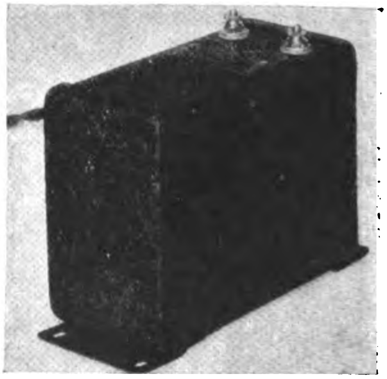
ve rating:
Filament voltage—3.
Filament current—.065 ampere.
Plate voltage—16.5 to 90.
Negative grid bias—0 to 4.5 volts.

e characteristics (with a plate voltage of 90 and a negative grid bias of 4.5 volts), as determined in Popular Radio Testing Laboratory:
Plate resistance—16,900 ohms.
Amplification factor—7.
Mutual conductance—410 micromhos.
Plate current—2.4 milliamperes.

Usage: As a detector, high-frequency amplifier or low-frequency amplifier in receivers equipped with old-style UX-199 type sockets.

Outstanding features: Less microphonic than the average dry-cell valve.

Maker: DeForest Radio Co.



A Battery Charger That Requires No Attention

Name of instrument: Storage battery charger.

Description: This is a 2-ampere charger which consists of a step-down transformer and rectifier inclosed in a metal case. It is equipped with an extension cord and plug for connection to the AC lighting lines, and two output binding posts for connections to the battery. The rectifier used is the Raytheon cartridge type. A small fuse is included in the case to prevent damage to either the charger or the battery should the connections between the charger and the battery be reversed. The charger requires absolutely no attention except to turn it "on" and "off."

Usage: For charging 6-volt storage batteries from the alternating-current, house-lighting lines.

Outstanding features: Extremely small in size. Requires no attention.

Maker: Thordarson Electric Mfg. Co.

(*Department continued on page 392*)

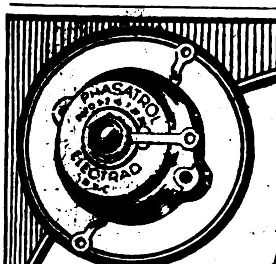
Write today for your copy of

"Copper Shielding for Radio"

This new book shows how to improve the reception of your set. There is no charge.

Copper shielding means greater selectivity and sensitivity.

COPPER & BRASS
RESEARCH ASSOCIATION
25 Broadway, New York



Licensed by Rider Radio Corporation.
Pats. Pending.
Patented 5-2-'16.
Patented 7-27-'26.

Don't Endure Oscillations!

"Phasatrols"

Reg. U. S. Pat. Off.

A true balancing device for Radio frequency amplifiers

Price - - $2.75

Either in the set you own or the one you intend building, solve the problem of proper control of oscillation by simply installing Phasatrol.

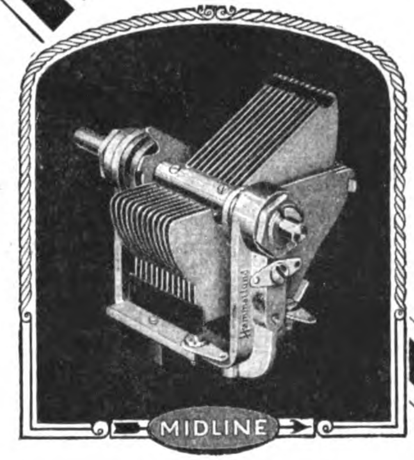
PHASATROLS make tuning easier. Endorsed and used by experts. Very easy to install in any tuned, untuned or reflex R. F. set.

Write for free hook-up circular for any set or circuit.

Dept. 58B, 175 Varick St., New York, N. Y.

ELECTRAD

Laurence Cockaday's *New* "LC - 28" RECEIVER *Uses* HAMMARLUND CONDENSERS *and* DRUM DIAL



Accurately Matched

A distinctive feature of the new "LC-28" Receiver is its inherently balanced R. F. amplifier—three stages, perfectly matched and stabilized without the addition of neutralizing devices of any kind. This means efficiency plus and it was attained in the simplest, most logical way—the designer selected Hammarlund "Midline" Condensers not only because past experience has proved their superior design and performance, but also because they are ACCURATELY MATCHED with laboratory precision.

***Illuminated* DRUM DIAL**

Beautifully designed and substantially built. Gives distinction to any receiver and greatly simplifies tuning. Two-finger control. Illuminated from back of panel.

HAMMARLUND MANUFACTURING COMPANY
424-438 W. 33rd Street, New York

Many other leading radio designers have officially specified Hammarlund Precision Products for their latest receivers.

For Better Radio
Hammarlund
PRECISION
PRODUCTS

Dealer inquiries invited concerning several other new, interesting Hammarlund developments having a wide sales appeal.

A New A.C. Superheterodyne

***Described in the* December POPULAR RADIO**

Here is an article, fresh from the Laboratory, describing in detail the construction of a 6-tube AC Superheterodyne Pack for use with the LC-28 Unipac. It is AC throughout and amazingly simple to build. No serious fan can afford to miss this issue of POPULAR RADIO.

$3.00 *sent to the Subscription Department guarantees the safe arrival of each new issue.*

POPULAR RADIO, INC.
119 West 57th Street **New York, N. Y.**

millions may now enjoy the thrill of improved reception with MUTER B POWER

When your favorite radio hour is at hand! That's the time to settle back at ease and appreciate the real joy of clear, true, uninterrupted reception with the new Muter B Power Unit. The Muter Policy of "Dependable quality at a popular price" has brought this enjoyment within the means of every set owner. Convince yourself of the pleasure that can now be yours by an early tryout on our liberal guarantee of satisfaction.

Outstanding Characteristics

FIXED CONTROLS used with separate fixed voltage taps, giving ample range and definite knowledge of voltage received.

CAPACITY ten tubes or seven with a power tube.

RATING 40 mils at 150 volts. Will deliver 180 volts for new type 171 power tube.

Condensers: Muter filter condensers of ample capacity and acknowledged quality ensure long life and uniform output.

Uses Standard Cunningham or Radio Corp. Full Wave Vacuum Rectifying Tube because of long life and stability. Used on 110 to 120 volt, 60 cycle A. C. Current Only.

No Noise—No Vibration

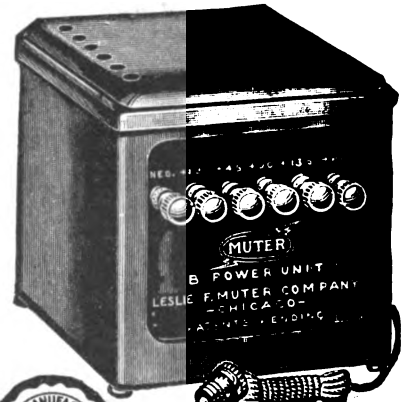
Model 3000 for 280 or 213 Tube $24.50
Model 3050 for Raytheon B. H. Tube $26.00

Ask Your Dealer—or Send Coupon

Prompt shipment, postpaid, will be made upon receipt of price—or C. O. D. plus postage, if you prefer. Make this moderate investment with perfect assurance that of all the enjoyment Radio offers you will find none greater than the difference in reception with Muter "B" Power.

LESLIE F. MUTER CO.
Dept. 806-PX
76th and Greenwood Ave., CHICAGO, ILL.

MUTER DEPENDABLE PRODUCTS

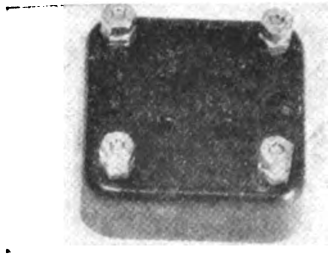


RADIO MANUFACTURERS ASSOCIATION RMA MEMBER

LESLIE F. MUTER CO.
76th and Greenwood Ave.,
Dept. 806-PX, Chicago, Ill.

☐Send $24.50 model for 280 or 213 Tube.
☐Send $26.00 model for Raytheon B. H. Tube.
☐Payment is enclosed. You pay postage.
☐Send C. O. D. plus postage.
☐Send me complete Muter Catalog.

Name..............................
Address..............................
City....................State..........



It Is Easy to Get the Valve Into This Socket

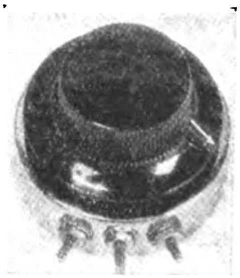
Name of instrument: Vacuum-valve socket.

Description: This rectangular base fits flat on the sub-panel or baseboard of the receiver. Within it are mounted the spring contact terminals. These contacts are in the form of double springs and are securely fastened in position to guarantee a firm sliding contact on the valve prongs. For added strength the base is reinforced at four points. Two screw holes are provided for the mounting screws. Both metal binding posts and soldering lugs are used on the four terminals. The four holes into which the valve prongs fit are tapered in such a way as to make it easy to fit the valve into the socket.

Usage: As the holder for the vacuum valves in a radio receiver.

Outstanding features: Positive contacts. Strong construction. Easy to insert valves.

Maker: Herbert H. Frost, Inc.



This Unit Provides a Smooth Voltage Control

Name of instrument: Variable resistor.

Description: This unit consists of a nickel-plated, cylindrical metal case with the wall lined with a special resistance composition. The contact member or arm is equipped with a pair of rollers so arranged that as the arm is turned these rollers press against the resistance, thus making the necessary contact. There is no sliding or scraping and for that reason there is no wear on the resistance material. The roller type of contact provides smooth variation of the resistance. The instrument is equipped with a composition knob and may be mounted on a receiver panel by means of a single hole in the panel. This unit is obtainable in various resistance values with maximums ranging from 400 to 500,000 ohms.

Usage: In the plate or grid circuits of receivers for the purpose of stabilizing the high-frequency circuits or controlling regeneration. In "B" power-packs for output voltage control. As plate or grid resistors in resistance-coupled amplifiers.

Outstanding features: Neat appearance. Smooth operation. Positive contact. May be obtained with two or three terminals for use as a series resistance or potentiometer.

Maker: Herbert H. Frost, Inc.

Knickerbocker 4
THE WONDER SET
2-Dial Karas Equamatic
5 Tube Receiver

THESE two famous receivers, as well as scores of other well-known sets, owe no small part of their marvelous performance to the use of Karas Parts. Karas Condensers, Transformers, Filters, Coils and Dials are the perfected products of a factory which has been building precision electrical apparatus for more than a third of a century. Write today for complete catalog of all Karas Parts, and details of the Knickerbocker 4 and the 2-Dial Karas Equamatic.

KARAS ELECTRIC CO.
4029-K North Rockwell Street
CHICAGO

2-DIAL KARAS EQUAMATIC USE KARAS PARTS KNICKERBOCKER "4"

PRICES SLASHED On Standard Radio Products

Now ready! Harry Alter's price list for November. Saves you money on every requirement—not merely on a few "bait" bargains. Check and prove my unheard-of values. Test Alter's "Minute-Man" shipping service. Send for this big catalog—free.

(*NOTE: We Sell to Dealers Only*)

The Harry Alter Co.
1749 Michigan Ave., Chicago, Ill.

MAIL THIS COUPON

The Harry Alter Co.
1749 Michigan Ave., Chicago
Send at once a copy of your November price guide.

Name..............................
Address..............................
City....................State..........

Townsend
"B" Socket Power
"Best in World!"

Says A. W. GALE
of Gloversville, N. Y.

COMPLETE

Only $6^{85}

$1^{00} Down
Balance
C.O.D.

Below is a reproduction of Mr. Gale's letter of May 8th, 1927.

48 W. Fulton St.,
Gloversville, N. Y.

"Received the Townsend all O. K. *It is the best in the World and that is saying some.* I have a Radiola 4 tube. Get more stations than ever before. Some of them are CFCF, CKNC, WGY, KDKA, WGZ, WIP, WWJ, KTHS, KOP, KOA, WHAS, WTAM and KSD—besides 4 in Chicago, all in the East and then some."

A. W. Gale.

Replaces "B" Batteries

The letter above speaks for itself—proves beyond doubt that the Townsend "B" Socket Power is the most remarkable value in Radio today. Sam E. Fry of 1415 Holmes St., Kansas City, Mo., writes: "Eliminator works fine. Showed it to a friend and he wants one also. I will say it sure beats batteries. I get stations I never got before on a 6 tube set." Charles Ellis, 88 Jones Ave., Columbus, Ohio, says, "Your Eliminator is working fine. Have had station WJAX and others over 1,000 miles distant. Picked up 22 different stations one evening and around 30 another time. My neighbor has a $27.50 Eliminator and I don't see that it works any better than yours."

Delivers up to 100 volts on any set, on D. C. or A. C.—any cycle. Full tone, clarity and volume.

Tested and approved by America's leading Radio authorities—Radio News and Popular Radio Laboratories

ORDER TODAY!

Simply fill out the coupon and slip it into an envelope with only $1.00 and mail at once. Your Townsend "B" Socket Power Unit will be sent promptly. Deposit only $5.85 plus postage with the postman. Try out for 10 days—then if not delighted with improvement in reception, return it to us and purchase price will be refunded.

TOWNSEND LABORATORIES
713 Townsend St., Dept. 19, Chicago, Ill.

10 Days
FREE
TRIAL
You are the
Judge!

Attach Only $1.00
to this Coupon!
SEND TODAY

TOWNSEND
LABORATORIES
713 Townsend St.
Dept. 19, Chicago, Ill.

Gentlemen: Attached find $1.00. Kindly send at once Townsend "B" Socket Power Unit, C. O. D., for $5.85, plus postage, on guaranteed 10-day free trial.

Name...

Address..

City............................*State*...............

Panels for Magnaformer and Other Kits

FORMICA is supplying handsomely decorated and drilled front and sub panels for the Magnaformer Circuit; also Tyrman front and sub panels, H. F. L. new hook-up; Karas new hook-up; World's Record Ten; Camfield Nine and Camfield Seven.

Other kits for which Formica panels are available are Madison-Moore, Melo-Heald, Victoreen, St. James Infradyne and E. T. Flewelling's Super Eight.

These panels enable the home constructor to build a set equal in appearance and efficiency to the best manufactured receivers.

Sold by leading dealers and jobbers everywhere

The FORMICA INSULATION COMPANY
4641 Spring Grove Avenue Cincinnati, Ohio

Any parts—dealer or jobber can get Formica panels for you

FORMICA

Formica has a Complete Service on Insulating Parts for the Radio Manufacturer

POPULAR RADIO DEALER AND JOBBER LISTS AVAILABLE TO MANUFACTURERS

The Service Bureau of POPULAR RADIO is able to place at the disposal of radio manufacturers a list of over 21,000 radio dealers, 3,926 radio manufacturers, 1,746 jobbers and 326 manufacturers' representatives. These addresses are immediately available for circularizing prospects for new Fall lines, and more detailed information and rates will be gladly supplied to those who wish to take advantage of what is without doubt one of the most carefully kept lists at present offered for use.

Address all inquiries to:

SERVICE BUREAU
POPULAR RADIO, Inc.
119 West 57th Street New York, N. Y.

ZRF

33% Greater Amplification from YOUR RF Sockets

L. M. Cockaday—technical editor of POPULAR RADIO—made a careful study of radio-frequency amplification tube requirements. Co-operating with Mr. Cockaday, Zetka Laboratories have produced the ZRF—a ¼ amp. special duty Radio-Frequency amplifier—resulting in over 33% greater amplification per stage than is possible with standard tubes.

He found in RF the main factors to be a low input capacity between the elements (which goes with a low mu) and a low plate impedance.

Try ZRF in the radio-frequency stages of YOUR SET. Only $4.50 each. For complete characteristics of this remarkable new tube, write

ZETKA LABORATORIES, Inc., 73 Winthrop St., Newark, N. J.

ZETKA

The *Clear-Glass* Tube

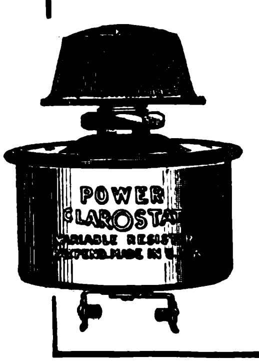
RESISTANCE RANGE

PLUS

FINE adjustment of resistance calls for limited range in most variable resistors.

But the Clarostat is different; it has not one turn, or part of a turn, of its knob to cover the resistance range, *but several turns*. Therefore, the resistance range of the Clarostat is that of the usual variable resistor, plus several more turns. Instead of practically zero to several hundred thousand ohms, the Universal Range Clarostat, for example, provides a range of practically zero to 5,000,000 ohms—and with that astounding range it has a more gradual adjustment than any other device with a tenth that range. One Clarostat, therefore, does the work of many variable resistors of other types. But the main thing about Clarostat is reliability. It combines the *reliability* of fixed resistance with the *convenience* of variable resistance.

CLAROSTAT



is the standard of variable resistance. And as with all standards, it is widely copied in appearance. Don't be fooled! Watch for the green box, and the name stamped on the Clarostat itself.

Your local dealer has the three types of Clarostat in stock. Watch the radio columns for how to better your present set, or how to build a better set, with Clarostats. Write us for descriptive literature.

AMERICAN MECHANICAL LABORATORIES, INC.
Specialists in Variable Resistors
285 N. Sixth Street, Brooklyn, N. Y.

Transoceanic Calls Heard

POPULAR RADIO'S "Calls Heard" Department is ready to serve all American amateurs by forwarding their calls heard (QSL) cards to their proper destination in foreign countries. These cards are delivered through agents in those countries who have or can obtain knowledge of the present address of foreign amateurs. POPULAR RADIO is also doing the foreign amateur the service of forwarding his QSL cards to the proper destination in this country. In addition, the magazine will publish a monthly list in the "Transoceanic Calls Heard" column. Address your cards to the foreign amateurs by call number and enclose them in envelopes to—

The Calls Heard Editor
POPULAR RADIO
119 West 57th Street, New York

THE following stations in the United States were received and logged at the amateur station of M. Meidieux (EF-8ARO), at Belfort, France, using a receiver with detector and one stage of low frequency:

1ADM, 1AQT, 1ARC, 1AVL, 1CNZ, 1VW, 2ADL, 2AYJ, 2AZK, 2CRB, 2CUQ, 2CYX, 2GX, 2HC, 2IZ, 2JN, 2PZ, 2TR, 3ACW, 3AEF, 3AFU, 3AKS, 3QE. 3SZ, 4DX, 4LK, 4RN, 4RR, 8ALY, 8BTH, 8DHX, 8JQ, 9ARA, 9DIJ.

THE following stations in the United States were received and logged at the amateur station of Roger Pieton (R390), at 92, Rue Riquet, Toulouse, France, using a Bourne circuit with one stage of low frequency:

1AAE, 1AD, 1ADM, 1ADK, 1ACD, 1AWE, 1BBM, 1BYV, 1BCV, 1BHS, 1BYF, 1BEB, 1BUX, 1CCZ, 1CM, 1CMX, 1CKP, 1CMF, 1CNZ, 1CPB, 1CRA, 1FN, 1GWE, 1IA, 1ISU, 1LRC, 1SAT, 1SMG, 1SW, 1VW, 1XV, 2AEB, 2AGN, 2AH, 2AHM, 2ALY, 2AMD, 2AML, 2AMJ, 2AWQ, 2AYJ, 2BLB, 2BSC, 2CH, 2EXE, 2GP, 2GX, 2JN, 2NM, 2MX, 2OX, 2TKX, 2TOG, 2TP, 2TTH, 2TXE, 2XAD, 3AH, 3BBG, 3BTQ, 3BWJ, 3CEC, 3CKJ, 3JM, 3QP, 3TN, 3XAE, 4AU, 4DV, 4FA, 4LP, 4OH, 4QY, 4RN, 4RP, 4XE, 5AGA, 5AXS, 5ACL, 5MX, 5JS. 5SH, 5UK, 6AGR, 6AZS, 6BAM, 6BDN, 8ACL, 8ACZ, 8ADE, 8ADG, 8AGA, 8AHE, 8ALY, 8ASB, 8AVL, 8AUL, 8AUT, 8BES, 8BOX, 8CCQ, 8CCS, 8CCA, 8CED, 8CEK, 8CLP, 8CSE, 8COA, 8DDN, 8DEM, 8DGB, 8DGX, 8DHX, 8DME, 8DOD, 8DON, 8DSF, 8LL, 9BAV, 9BBT, 9BDQ, 9BZI, 9CFN, 9CN, 9DB, 9DDP, 9DDZ, 9EFK, 9EFX, 9EIM.

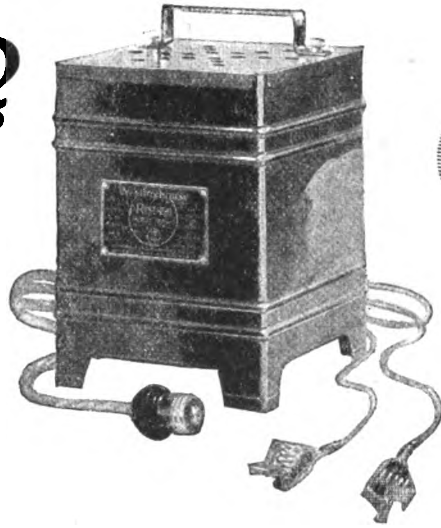
THE following stations in the United States were received and logged at the amateur station of L. Berger (EF-8OEO), at Bayonne, France, using a three-circuit, low-loss receiver:

1ADM, 1BAT, 1CMX. 1SZ, 1VC, 2ASE, 2ATS, 2BOW, 2BIQ, 2BXU, 3BQZ, 3HS, 3MB, 3QW, 3QE, 3SZ, 3TF, 4RM, 5WZ, 6FU, 8AGK, 8AJN, 8BEN, 8BJB, 8BTH, 8CNH, 8DJG, 8JQ, 9ADK, 9AEB.

THE following stations in the United States were received and logged at the amateur station of J. Gimat (R221), at 14, Rue Riquet, Toulouse, France, using a Schnell circuit:

4DV, 4FA, 4IZ, 4KU, 4NH, 4OH, 4QY, 4TU, 4XE, 5ACL, 5AGA, 5AGQ, 5AX, 5XE, 6BZF, 7SF, 9ARA, 9ARK, 9BBH. 9BZI, 9CFN, 9CMV, 9CN.

Weak batteries?
Never with
Rectigon
The Two-Rate Charger



CONNECT your battery permanently to Rectigon—it will automatically "trickle in" new power to replace what you use; or if unusually long periods of set operation drain the battery faster than a "trickle will recharge, just swing the leads over to Rectigon's high-rate terminals and bring the battery to full charge quickly and without bother.

You need only the one charger to keep your "A" at top notch for every program. Rectigon will recharge your wet "B" just as easily.

Rectigon is made by Westinghouse — broadcasters of first radio program from KDKA, back in 1920. Rectigon is safe, compact and simple. No moving parts to break or wear out, nothing to damage the set even if you tune in while charging. Get Rectigon at your dealer's.

3 Ampere Rectigon
~~$18.00~~
now
$14.00

5 Ampere Rectigon
~~$28.00~~
now
$24.00

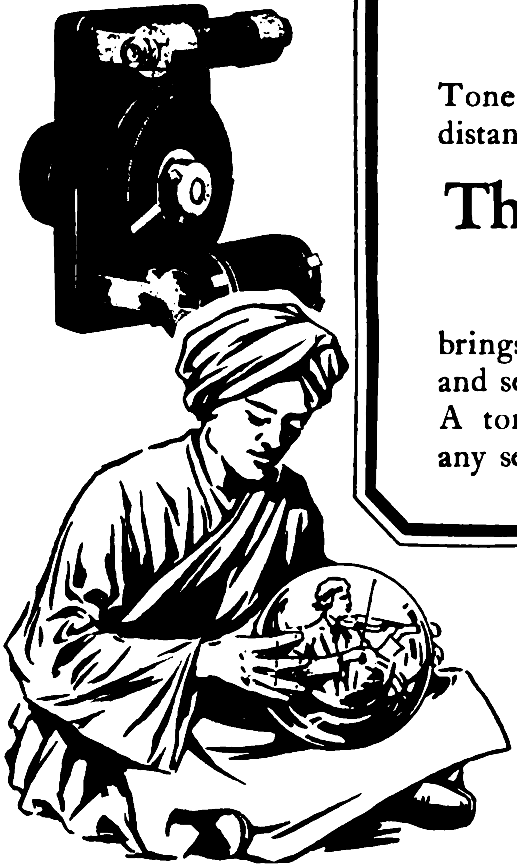
Westinghouse Rectigon
Battery Charger

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA.
Offices in All Principal Cities *Representatives Everywhere*
Tune in with KDKA—KYW—WBZ—WBZA

Rectox — for trickle charging only. Just attach the leads to your battery and connect Rectox to the light line. Left permanently on charge, at either ½ or ¾-ampere charging rate, it keeps your "A" battery power peppy. No messy liquids, no moving parts, nothing to wear out.

Besides Rectigon and Rectox for better battery charging, Westinghouse also makes Micarta panels and tubing for better insulation, and radio testing instruments for better reception.

WESTINGHOUSE ELECTRIC



Crystal Clear Tones

Tone quality is what radio listeners want. Volume and distance mean nothing if the tones are blurred.

The Carborundum Stabilizing Detector Unit

REG. U. S. PAT. OFF.

brings you natural tones clear as crystal with assured volume and selectivity.
A tone perfecting unit that can be used on practically any set.

$3.50 in U.S.A. Dealer or direct. Or the Carborundum Detector alone for $1.50.

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.
CANADIAN CARBORUNDUM CO., LTD.
NIAGARA FALLS, ONT.

SALES OFFICES AND WAREHOUSES IN New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Milwaukee, Grand Rapids

The Carborundum Co., Ltd.
Manchester, England

Deutsche Carborundum Werke
Dusseldorf, Germany

The Carborundum Company
Niagara Falls, N. Y.

Send for free Hook-up Book D-5

Name ____________________

Street ____________________

City ____________________ State ________

Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of The Carborundum Company.

LC-28—$90.15

Kits ready for immediate shipment, no substitutions

4	—Hammerlund mid-line variable condensers .000275 mfd		$20.40
1	—Hammarlund double-drum dial		6.00
4	—Precision type 4B radio frequency transformers		12.50
3	—Samson high-frequency chokes, type 125		6.75
1	—Samson high-frequency chokes, type No. 85.		2.00
3	—Aerovox Moulded Condensers, .02 mfd.		4.50
1c	—Aerovox Moulded Condensers, .00025 mfd		.35
1	—Aerovox Moulded Condensers, .00075 mfd		.40
1	—Yaxley combination switch and rheostat, 6 ohms, No. 906–K		1.75
1	—Yaxley cable connector plug with cable, type 660		3.00
4	—Carter fixed resistances, 4 ohms, type 4H		1.00
2	—Carter No. 10 tipjacks	.20	.65
1	—Set insulating washers for tipjack	.05	
2	—"IMP" plugs cord tip type	.30	
1	—Antenna name plate	.05	
1	—Ground name plate	.05	
4	—Benjamin vibrationless sockets		3.00
1	—Lynch single resistance mounting		.35
1	—Lynch Suppressor, 500 ohms		1.50
1	—Lynch Suppressor, 600 ohms		1.50
1	—Lynch Suppressor, 700 ohms		1.50
1	—Durham metallized resistor, 6 megohms		.50
2	—Tait brackets		2.00
1	—Alcoa aluminum Chassis		7.50
4	—Sets special aluminum box shields for LC-28.		8.00
1	—Aluminum panel, 6x26 inch		4.50
1	—¼ inch extension shaft		.50
			$90.15

Magnaformer 9-8 Kits, $128.99

LC-27 Kits, $85.20

Dealers and Professional Set Builders write for Discounts

Wired sets in stock—write for prices

Transportation charges prepaid on retail sales when full remittance is received with order.

RADIO SERVICE CO.
P. O. Box 144 **Knoxville, Iowa**

POLYMET CONDENSERS

At All Dealers

Polymet Filter Condensers

They are selected by leading engineers and incorporated as standard equipment by nationally known manufacturers of receiving sets and power units. *Follow the leaders.*

Write for Polymet Catalog

POLYMET MFG. CORP.
599-601 Broadway, New York City

POLYMET

Easier tuning—correct tube oscillation—more volume and clearness with an X-L VARIO DENSER in your circuit.

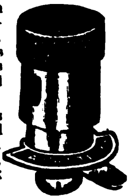
Specified and endorsed by foremost radio authorities in all leading circuits.

MODEL "N"—Micrometer adjustment easily made, assures exact oscillation control in all tuned radio frequency circuits, Neutrodyne, Roberts 2-tube, Browning-Drake, Silver's Knockout. Capacity range, 1.8 to 20 Mfd. Price, $1.00.

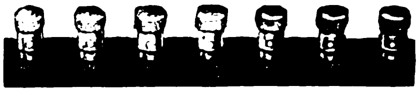
MODEL "G"—Obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in superheterodyne and positive grid bias in all sets. Capacity range, Model G-1, .00002 to .0001 Mfd. Model G-5, .0001 to .0005 Mfd. Model G-10, .0003 to .001 Mfd. Price, each, with grid clips, $1.50.

X-L PUSH POST—Push it down with your thumb, insert wire, remove pressure, wire is firmly held. Vibrations will not loosen, releases instantly. A push post that excels in appearance, action, service and convenience. Price, each, 15c.

PUSH POST PANEL—7 push posts mounted on black insulating panel with permanent white markings. Soldering lugs, raising bushings, screws for mounting, etc., in box complete. Price, $1.50.



X-L Push Post



X-L Push Post Panel

FREE—New, up-to-date book of wiring diagrams showing use of X-L units in the new LOFTIN-WHITE constant coupled radio frequency circuit, and in other popular hook-ups. Send for yours today.

X-L Radio Laboratories
2422 Lincoln Ave., Chicago, Ill.

THOUSANDS OF FANS HAVE WAITED FOR THESE AMERTRAN PUSH-PULL TRANSFORMERS!

THE intensive research work of AmerTran engineers has culminated in the new AmerTran push-pull units Nos. 151 and 152. With these new transformers one stage of AmerTran push-pull with power tubes following a first stage of AmerTran DeLuxe, provides for energy output to the speaker with less distortion than can be obtained with a single power tube.

With this system, tube distortion and harmonics are suppressed, and the slight hum caused by the raw AC on the filament of the power tube is entirely eliminated.

As in the case of the AmerTran DeLuxe transformers, the push-pull unit uses high permeability alloy cores. The multiple windings of the new unit are so arranged and balanced as to give high inductance coupling and minimum capacity coupling. The input transformer which works out of the plate of one amplifying tube to the grids of two power tubes has approximately the same primary impedance as the two-stage AmerTran DeLuxe.

Since various type of power tubes have different values of plate impedance, AmerTran has provided output transformers to correspond with the power tubes of the speakers which are most generally used. Impedance ratios are calculated for a greater transfer of energy for frequencies from 50 to 100 cycles because it is in the case of these low frequencies where more energy is required to drive the loudspeaker mechanism.

You may purchase these units from your local authorized AmerTran dealer, and they are available in the following types and prices:

Push - Pull Input Transformers, type 151	$15.00 each
Push - Pull Output Transformers, type 152 (impedance ratio 4 to 1) for 2 UX-210 or similar power tubes	$15.00 each
Push - Pull Output Transformers, type 271 (impedance ratio 2 to 1) for 2 UX-171 tubes connected push-pull	$15.00 each

AmerTran DeLuxe Transformers, available at your local dealers at a price of $10.00 each, have been accepted as standard by radio engineers throughout the world. AmerTran Power Transformers, Chokes, and Resistors for high quality amplification have also enjoyed leadership as the products of a house that for over twenty-six years has specialized in the building of transformer units of every description.

AMERICAN TRANSFORMER CO.

178 EMMET STREET

Transformer Builders for Over Twenty-Six Years

NEWARK, N. J.

You can always bank on Faradon

Whether you buy or build—the performance of your socket-power equipment can only be as reliable as the electrostatic condensers used.

Large manufacturers throughout the country have found Faradon Capacitors possess the qualities which are essential to reliability. Therefore they specify Faradon.

Take a leaf from their book and when you buy—either set, kit or for replacement—insist on the generally accepted standard or fixed condenser durability and specify Faradon Capacitors.

Your dealer can supply them in all desired capacitances. Ask for them by name—Faradon.

WIRELESS SPECIALTY APPARATUS COMPANY
Jamaica Plain, Boston, Mass., U. S. A.
Established 1907

Faradon

1282

Electrostatic condensers for all purposes

When the ball goes 'round the end for 40 yds.

--"You're there with a Crosley!"

The Crosley Radio Corporation:
Can you explain "balancing," so folks can understand it? We technical people know that Hazeltine's neutrodyne principle is a wonderful thing. If you can make it understandable to laymen you're good.

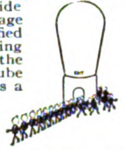
Yours truly,
F. D. PITTS CO.
Boston, Mass.

Nature always puts obstacles in our way. When men begin to study a new invention or discovery they find that there are many problems to solve before a successful device can be built. This was the case with the steam engine, the printing press, the automobile, the aeroplane, and every other major invention that you can think of.

The vacuum tube is, perhaps, one of the most remarkable inventions ever made. We found that we could use it to amplify the radio signals. But when we tried to tune these amplifiers, so that they would help us select the desired signal, we found that the vacuum had a tendency to misbehave.

SIGNAL VOLTAGES GOING INTO AMPLIFYING TUBE

When a tube is used to amplify, the output voltage is much stronger than the input voltage. This is the natural result of the amplification. But there is a path back through the tube through which some of the strong output voltage can get back to the input side of the tube. The voltage is then again amplified and again returns, getting stronger each time, the result being that the tube goes wild. It becomes a miniature broadcasting station on its own hook.



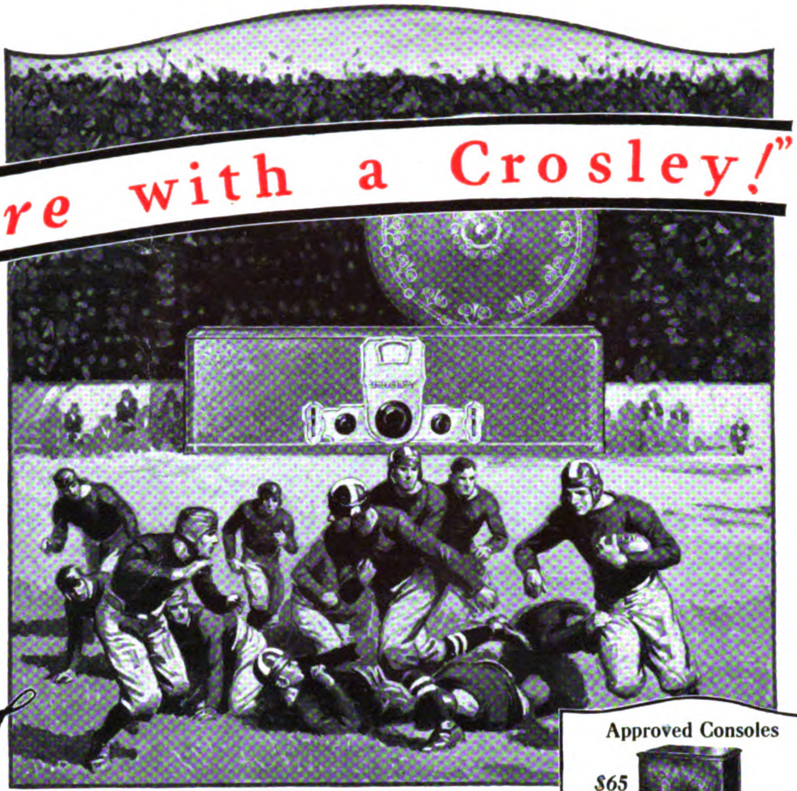
SIGNAL VOLTAGES LEAVING TUBE GREATLY AMPLIFIED BUT SOME RUN AROUND TO ENTRANCE AND CROWD IN WITH THE LITTLE INCOMING SIGNALS

If we can provide a second path from the output circuit to the input circuit, so arranged that the voltage which comes back through this second path is opposed to the voltage that comes back through the tube itself we can prevent the trouble. This is called "balancing" because the second path is adjusted so that it exactly balances the path through the tube.

AMPLIFIED SIGNALS RETURNING TO TUBE MIXING IT UP WITH INCOMING SIGNALS

HAZELTINE DIVIDES BOLSHEVIK VOLTAGES. BALANCING EACH OTHER BY OPPOSING EACH OTHER THEY CAUSE NO RUMPUS IN THE TUBE AND PROGRAM SIGNALS GO THROUGH AMPLIFIER WITHOUT INTERFERENCE

The Hazeltine method of balancing (or neutralizing) this path through the tube has several unique advantages over all the other methods that have been proposed. This is why Crosley radios use the Hazeltine "neutrodyne" method.



THIS new Crosley Bandbox

6 TUBE RECEIVER *de luxe*

is the national radio hit at $55.

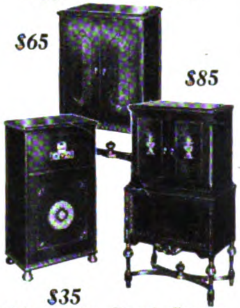
The "All American" radio of 1928! With license to participate in the enormous radio resources of The Radio Corporation of America, The General Electric Co., The Westinghouse Co., The American Telephone and Telegraph Co., and The Hazeltine and The Latour Corporations, the Crosley Bandbox of 1928 is an "eleven" of super-efficient features and amazing co-ordinated performance. In it are incorporated:

1—The best idea of balancing.
2—The best ideas of shielding.
3—The best ideas of sharp tuning.
4—The best idea of controlling volume.
5—The best idea of station selection.
6—The best idea of finish and color.
7—The best idea of power tube use.
8—The best idea of console installation.
9—The best idea of power supply connections by enclosing all leads in a cable.
10—The best idea of AC tube operation.
11—The best idea of converting AC current to necessary radio DC.

Operation of the Bandbox receiver from house current is possible with the AC model at $65, which uses the new amazing R.C.A. AC tubes. Power converter costs $60 more.

These new Bandbox receivers are now on display at over 16,000 Authorized Crosley dealers. Their faultless reception of the many wonderful events constantly on the air is proving such a startling demonstration that a national enthusiasm sweeps the country in the natural exclamation—"You're there with a Crosley!" If you cannot locate the nearest dealer, write Dept. 16, for his name and literature.

Approved Consoles



$65
$85
$35

Selected by Powel Crosley, Jr., as ideal, acoustically and mechanically for the installation of the Crosley "Bandbox." Genuine Musicone built in. Crosley dealers secure them from their jobbers through

H. T. ROBERTS CO.
1340 S. Michigan Ave.,
Chicago, Ill.
Sales Agents for Approved Console Factories
Showers Brothers Company
Bloomington, Ind.
The Wolf Mfg. Industries
Kokomo, Ind.

IMPROVED MUSICONES

Musicones improve the reception of any radio set. They are perfect affinities in beauty and reproductive effectiveness for Crosley Radios. A tilt-table model with brown mahogany finish stands 36 inches high, $27.50—16-inch Super-Musicone as pictured above with "Bandbox," $12.75—12-inch Ultra-Musicone, $9.75.

CROSLEY RADIO

THE CROSLEY RADIO CORPORATION
Powel Crosley, Jr., President, Cincinnati, Ohio
Prices slightly higher west of the Rocky Mts.

Crosley is licensed only for Radio Amateur, Experimental and Broadcast Reception

ALUMINUM

IN RADIO—A SIGN OF QUALITY

IN the fine sets of many of the leading manufacturers you will find that Aluminum is the prevailing metal for shielding, variable condensers and chasses.

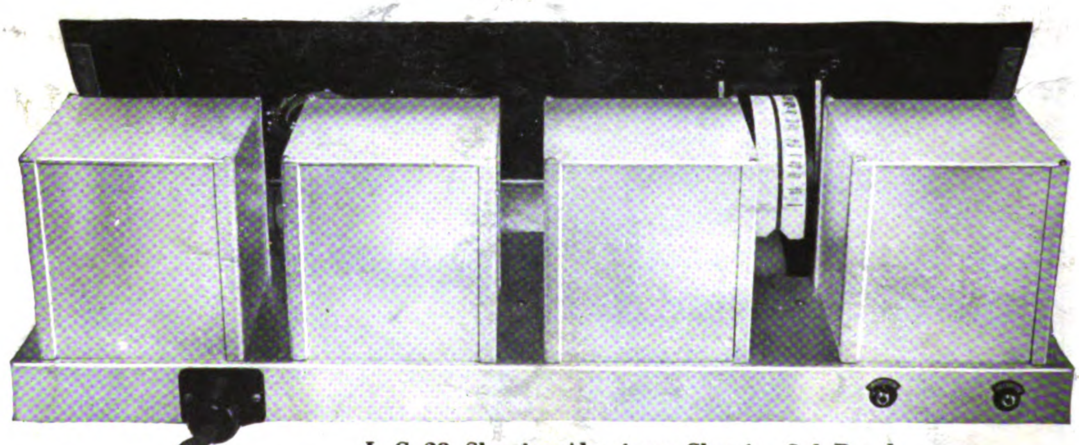
The reason for the widespread preference for Aluminum is expressed in three characteristics which are possessed in combination *only* by Aluminum:

High Electrical Conductivity, Workability, Lightness

Added to these characteristics, Aluminum is impervious to common corrosion.

The exhaustive experiments of leading manufacturers that have proved the superiority of Aluminum are a guide to the layman in building or in buying.

Information on the subject of Aluminum in Radio will be sent on request. Write for the booklet, "Aluminum for Radio." It is sent without cost.



L. C. 28, Showing Aluminum Chassis—Sub Panel and *"Junior"* Aluminum Box Shields.

The Aluminum Company of America manufacture the L.C. 28 Chassis-Sub Panel and the "Junior" Aluminum Box Shields specified for Cockaday's L.C. 28

ALUMINUM COMPANY OF AMERICA
2461 Oliver Building, Pittsburgh, Pa.
Offices in 18 Principal American Cities

ALUMINUM IN EVERY COMMERCIAL FORM

Engineeri
Libr y

Popular Radio

DECEMBER, 1927

25¢

FIRST!

A Marvelous New AC Superheterodyne

Getting 1928 Results with Your Old Receiver

The Best in Radio MUST BE CUSTOM BUILT!

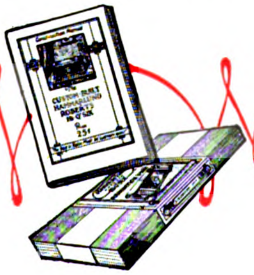
TAKE a circuit continuously improved over years of experiment by ten of America's leading manufacturers working as a unit towards radio perfection—add the finest parts in the industry—put them together under your own eyes, following the creators' simple instructions—and the result is the "Hi-Q Six"—*a CUSTOM-BUILT Receiver to meet your exact individual needs.*

"CUSTOM-BUILT" usually implies high cost. With the Hi-Q Six it means economy, for the complete approved parts cost only $95.80 and produce a radio instrument that cannot be duplicated in factory-made sets at more than twice the price.

"CUSTOM-BUILT" always means quality. So with the Hi-Q Six—equal and maximum amplification on *all* wave lengths—knife-like selectivity—super-sensitiveness—absolute freedom from oscillation—and tonal quality as natural as the original.

For complete details send 25 cents for a copy of "Hi-Q Construction Manual."

HAMMARLUND-ROBERTS, INC., 1182-B BROADWAY
NEW YORK CITY



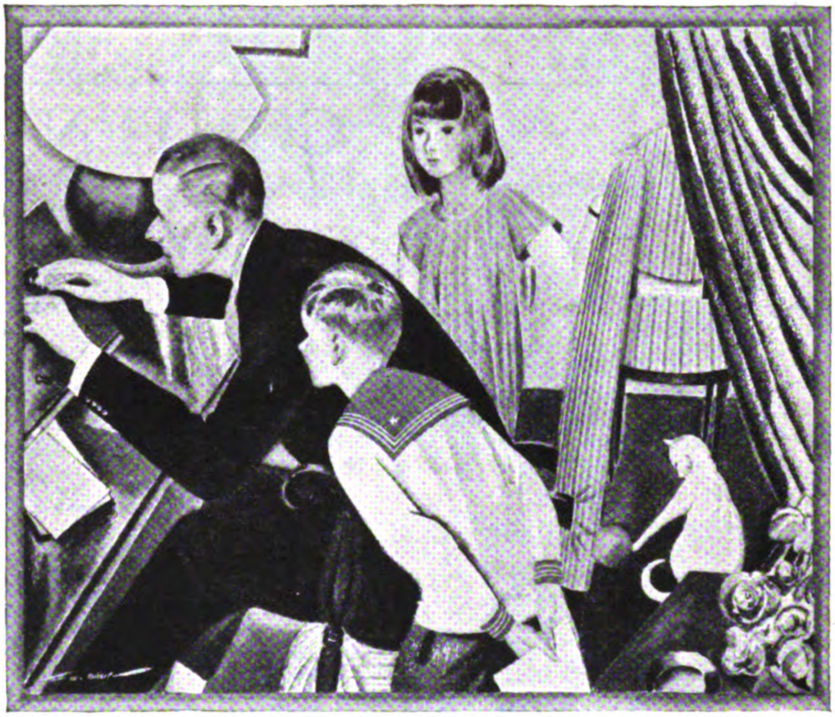
The basis of Radio Efficiency and Economy—the "Hi-Q" Book explains simply and completely how to build this remarkable receiver. The Hi-Q Foundation Unit includes ready-drilled steel chassis, decorated panel, shields and all special hardware—a combination which simplifies construction.

Hammarlund
ROBERTS
Hi-Q SIX

Associate Manufacturers

Silent Magic

Here is the Eveready Layerbilt "B" Battery No. 486, Eveready's longest-lasting provider of Battery Power.



Radio is better with *Battery* Power

TURN your radio dial, and presto! you turn your home into a theater, a concert hall, a lecture room, a cabaret, a church, or whatever you will. Turn the dial and your attentive ear does the rest. That is all there is to this magic of radio.

Or almost all. If a radio set is to work at its very best, attracting no attention to itself, creating for you the illusion that can be so convincing, you must pay a little attention to the kind of power you give it. There is but one direction, a simple one—use Battery Power. Only such power is steady, uniform, silent. It is called by scientists pure Direct Current. Any other kind of current in your radio set may put a hum into the purest note of a flute, a scratch into the song of the greatest singer, a rattle into the voice of any orator.

Don't tamper with tone. Beware of interfering with illusion. Power that reveals its presence by its noise is like a magician's assistant who gives the trick away. Use batteries—use the Eveready Layerbilt "B" Battery No. 486, the remarkable battery whose exclusive, patented construction makes it last longest. It offers you the gift of convenience, a gift that you will appreciate almost as much as you will cherish the perfection of reception that only Battery Power makes possible.

EVEREADY
Radio Batteries
-they last longer

NATIONAL CARBON CO., INC.
New York UCC San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time

WEAF–*New York*
WJAR–*Providence*
WEEI–*Boston*
WFI–*Philadelphia*
WGR–*Buffalo*
WCAE–*Pittsburgh*
WSAI–*Cincinnati*
WTAM–*Cleveland*
WWJ–*Detroit*
WGN–*Chicago*

WOC–*Davenport*
KSD–*St. Louis*
WCCO–{*Minneapolis* / *St. Paul*}
WDAF–*Kansas City*
WRC–*Washington*
WGY–*Schenectady*
WHAS–*Louisville*
WSB–*Atlanta*
WSM–*Nashville*

WMC–*Memphis*

Pacific Coast Stations—
9 P. M., Pacific Standard Time

KPO–KGO–*San Francisco*
KFOA–KOMO–*Seattle*
KFI–*Los Angeles*
KGW–*Portland*

The air is full of things you shouldn't miss

Popular Radio

EDITED *by* RAYMOND FRANCIS YATES

FOUNDED 1911

VOLUME XII December, 1927 NUMBER 6

CONTENTS

The 1,300 Horsepower Voices of Tomorrow's Broadcasting
FRONTISPIECE... ......PAGE 410

1,000,000-Watt Broadcasting
An expert tells what the future holds in the way of super-power never dreamed of a few years ago
By Dr. Alfred N. Goldsmith...PAGE 411

The New AC Superheterodyne
Constructional details for the first superheterodyne ever designed for complete AC operation
By Ernest R. Pfaff.......PAGE 413

Radio "Spooks" All Over the House..PAGE 416

Socket Power for Your Atwater Kent
By Charles L. Davis.......PAGE 417

The 1928 Browning-Drake
Advance information on a receiver that will outdo all of its popular predecessors
By Glenn Browning.......PAGE 418

Radio on Tanks..................PAGE 419

An Amazing Discovery in Resistance-Coupled Amplifiers
Constructional details for an amplifier designed by Manfred von Ardenne, the German radio wizard
By Albert G. Craig.......PAGE 420

Tuning with a Push Button
By Elmer E. Burns.......PAGE 422

Operating the Magnaformer
By William Steinke.......PAGE 423

Interference.......................PAGE 425

The Octa-monic Circuit
Further information on the radically new circuit that employs "harmonic detection"
By John Brennan........PAGE 426

The Thordarson Power-Pack Amplifier
Constructional details for a combination "B" power-pack and 210 power-valve amplifier
By Morris M. Silver......PAGE 428

New York's Radio Row...........PAGE 430

A Measurement Chart
By Raoul J. Hoffman, A.M.E...PAGE 431

The Harkness Counterfonic
Advance information on a receiver with a low-frequency amplifier of remarkable quality
By Carl Dorf..........PAGE 432

The New Science of Soldering
By P. C. Ripley.........PAGE 434

The Hammarlund Hi-Q "Six"
Suggestions that will help you operate this new receiver with the best results
By Raymond Francis Yates....PAGE 435

What's New in Radio
By the Technical Staff......PAGE 437

An LC-28 Amplifier
How to use the AmerTran power-pack amplifier in conjunction with the LC-28 high-frequency pack
By Laurence M. Cockaday....PAGE 441

An SOS Message That Sends Itself...PAGE 443

The Lynch "Five"
Operating pointers for this extraordinary and inexpensive receiver
By S. Gordon Taylor......PAGE 444

Your Laboratory Tools
By Lowell Madden, Jr......PAGE 445

If You Live in a Building with a Steel Framework—
By R. W. King.........PAGE 448

DEPARTMENTS

In the World's Laboratories......*Dr. E. E. Free*.........462
With the Inventors..............*William G. H. Finch*...482

VOLUME XII DECEMBER, 1927 NUMBER 6

Published monthly by Popular Radio, Inc., 119 West 57th St., New York, N. Y.; telephone number. Circle 8180; Douglas H. Cooke, President and Treasurer; Laurence M. Cockaday, Secretary; Emma A. Harm, Asst. Treasurer. Price, 25 cents a copy; subscription, $3.00 a year in the U. S., Canada and all countries within the domestic postal zone; elsewhere, $3.50 a year, payable in advance. The International News Company, Ltd., No. 5 Bream's Bldg., London, E. C. 4, sole distributors in England. Entered as second-class matter April 7, 1922, at the Post Office at New York, N. Y. under the act of March 3, 1879. Additional entry at Jamaica, L. I., N. Y. Copyright 1927, and title registered as a trade-mark by Popular Radio, Inc. Copyright in Great Britain by Popular Radio, Inc., 6 Henrietta St., Covent Garden, W. C., London, England. *For advertising rates, address* Popular Radio, Inc., 119 West 57th St., New York; or 225 North Michigan Ave., Chicago.
Printed in U. S. A.

CHARLES L. DAVIS, *Managing Editor*
LAURENCE M. COCKADAY, *Technical Editor*
E. E. FREE, Ph.D., *Contributing Editor*

For These Four Reasons

Arcturize your present Radio Set—enjoy all the benefits of A-C Power from your light socket with

ARCTURUS A-C TUBES

Detector ▾ Amplifier ▾ Power

Arcturus A-C Tubes
Have 4 Outstanding Features

1. Exceptional tone quality, volume and sensitivity. 2. Readily adaptable to all circuits using standard sockets. 3. Perfect operation under all normal line voltage variations. 4. Free from hum.

If you have been awaiting the perfection of A-C Tubes before modernizing your present set, send at once for detailed information on the operating characteristics of Arcturus A-C Tubes.

Ask Your Dealer

It doesn't take long or cost much to install Arcturus A-C Tubes in your present set. Your dealer's service man can get engineering instructions for the few simple changes in wiring that are necessary. Always remember that in changing over your set for A-C operation, Arcturus A-C Tubes require the least changes in wiring.

For the Technical Man

The unique advantages which we claim for Arcturus A-C Tubes are directly traceable to unique features of construction and exceptional operating characteristics.

The exceptional long life of Arcturus Tubes is due to the enormous electron supply resulting from the heater operating at a low temperature.

The highly efficient cathode is responsible for the unusual sensitivity of Arcturus A-C Tubes, and for the exceptional volume and tone quality which their use insures. This cathode produces: 1. A high amplification factor (10.5). 2. A low plate impedance (9,000 ohms). 3. A high mutual conductance (1160 micromhos).

Since the base of the Arcturus A-C Tube is of the standard four prong type, no additional terminals are required, making Arcturus Tubes adaptable to existing circuits with all the simplicity of D-C tubes. No center taps or balancing are required. A common toy transformer may be used. Filament voltage is the same (15 volts) for all types—detector, amplifier and power.

The freedom from hum which is one of the most important features of Arcturus A-C Tubes is due to the use of low A-C current, only 0.35 ampere. (Disturbing electro-magnetic fields are proportional to alternating current—not voltage.) Arcturus Tubes in all stages are four element tubes with indirectly heated cathodes.

Normal variations in line voltage do not affect the operation of Arcturus A-C Tubes. The amplification factor is practically constant over a wide range of filament voltages—13.0 to 18.0 volts.

The use of a heavy carbon filament enables Arcturus A-C Tubes to withstand even an unusual overload.

ARCTURUS RADIO COMPANY, INC.
257 Sherman Avenue, Newark, N. J.

A PAGE WITH THE EDITOR

From a photograph made for POPULAR RADIO

POPULAR RADIO SERVES THE RADIO PUBLIC

In the new laboratory of POPULAR RADIO, *shown above, the testing of new radio apparatus, which* POPULAR RADIO *has been doing in the past as a service to the radio public, is being continued on a larger scale and with greater accuracy than ever before. Increased floor space and better testing apparatus will give an opportunity for service that no other magazine can offer.*

GLENN FRANK, that amiable philosopher who does so much constructive thinking for the American people, is quoted from the *Child Welfare Magazine* as follows:

"The future of America is in the hands of two men—*the investigator and the interpreter*. We shall never lack for the administrator, the third man needed to complete this trinity of social servants. And we have an ample supply of investigators, but there is a shortage of readable and responsible interpreters, men who can effectively play mediator between specialist and layman. The practical value of every social invention or material discovery depends upon its being adequately interpreted to the masses. Science owes its effective ministry as much to the interpretative mind as to the creative mind. The knowledge of mankind is advanced by the investigator, but the investigator is not always the best interpreter of his discoveries. Rarely, in fact, do the genius for exploration and the genius for exposition meet in the same mind.

"Democracy of politics depends on democracy of thought. 'When the interval between the intellectual classes and the practical classes is too great,' says Buckle, 'the former will possess no influence, the latter will reap no benefit.' A dozen fields of thought are to-day congested with knowledge that the physical and social sciences have unearthed, and the whole tone and temper of American life can be lifted by putting this knowledge into general circulation. But where are the interpreters with the training and the willingness to think their way through this knowledge and translate it into the language of the street?

"I raise the recruiting trumpet for the interpreters."

* *

HAD Dr. Frank set to the task of outlining the function of POPULAR RADIO he could not have done so more effectively. For six years this publication has used its resources that it might perform the function of interpreter with honesty and authority, believing always that a function of this sort is one of the prime requisites of the mechanical age in which we move.

* *

AFTER having received a number of letters questioning the license we have taken in using the term "valve" in place of "tube," we feel constrained to say something in defense of this policy. One slightly irate reader complains with some feeling that we have been "high hatting" him. POPULAR RADIO obviously has no interest in "high hatting" its readers, but it does have a sincere desire to keep its terminology as scientifically accurate as possible, and, following the growing tendency of the radio engineering profession, it has forsaken the ambiguous term "tube" for the more descriptive one of "valve." After all, a tube may mean a container for toothpaste or the Hudson River Vehicular Tunnel.

* *

POPULAR RADIO feels especially gratified to be the first publication to present the details of a simplified superheterodyne employing the new AC valves. The description of this unusual receiver will be found on page 413 of this issue. Those who have the superheterodyne fever have never been presented with a better opportunity to build the receiver of their ideals with a minimum of expense and be assured of a maximum of performance.

* *

FOR several years the editors of POPULAR RADIO have attempted to interest Dr. Goldsmith (Chief Broadcast Engineer of the Radio Corporation of America) in the preparation of a manuscript for publication. Diligence has won out, and in this number (page 411) Dr. Goldsmith lays down his somewhat startling views on the broadcasting engines of the immediate future. Engineers used to talk timidly about 5,000 watts, and now Dr. Goldsmith does not care who hears him predict the construction of stations requiring 1,000 kilowatts of power. To our way of thinking, he presents the true spirit of engineering progress in his startling prognostications. And we have long since grown weary of the engineering pussy-footers who are afraid to appraise fully the acumen and daring of their own profession.

* *

THE description of the Thordarson power-pack and amplifier in this issue once again demonstrates the ease with which an old receiver can be modernized with new power equipment.

* *

DUE to the press of editorial matter, POPULAR RADIO had to postpone the article on the new amplifier perfected by Manfred von Ardenne, which had been announced for a previous number. In giving the constructional details in this issue (pages 420-421), we feel certain that the astonishing quality of reproduction and the compactness of the unit will recommend it to every radio fan who is looking for better low-frequency amplification.

Raymond F. Yates

FERRANTI A. F. 4 TRANSFORMERS

exclusively specified for the Magnaformer 9-8 Circuit

Audio Frequency Transformer Type AF-4 $8.50

A transformer giving exceptionally uniform amplification at a moderate price. All types tested to 1000 volts between windings and between windings and ground.

Output Transformer Type OP-1 $10.00

The finishing touch of the modern radio set. Will purify and improve the tone of your speaker. Prevents possible accidents from shocks and burnouts by eliminating D. C. and high plate voltage at speaker.

Now your receiver can give you ...TRUER MUSICAL RECEPTION!

Faithful reproduction of the deepest bass note, the trill of the highest treble note and exact reproductions of all the in-betweens! This true rendition of the original performance delights possessors of sets equipped with Ferranti audio frequency transformers.

Amplification of every sound so that the music is delivered to you in the original rich, mellow tones in which it is played . . . this is what Ferranti transformers give you—and give it with the utmost in volume. Those weak notes which often escape the ear of the listener are reproduced with unfailing accuracy and with a distinctness that labels the whole result as—true musical reception!

Ferranti transformers mean quality reception. Whether you assemble your own set or buy it complete, an investment in Ferranti audio frequency transformers will pay big dividends in the shape of faithful tone reproductions!

FERRANTI

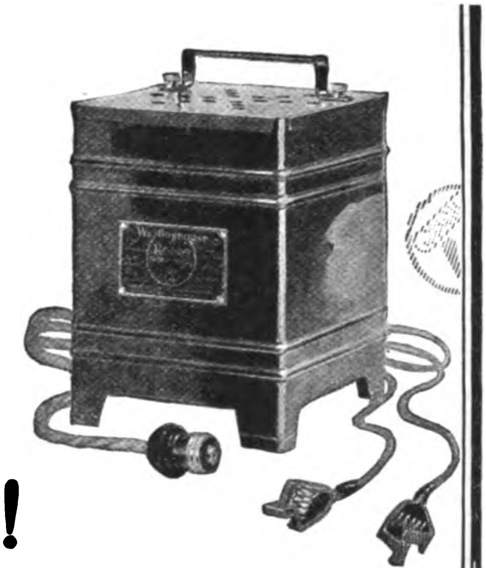
Audio Frequency Transformers

FERRANTI, Incorporated
130 West 42nd Street, New York, N. Y.

FERRANTI, Ltd.
Hollinwood, England

FERRANTI ELECTRIC, Ltd.
Toronto, Ontario, Canada

Want trickle charging? Want *full rate charging too?*



then you want Rectigon!

YOU need only one charger—the Westinghouse Rectigon.

Rectigon gives you two charging rates—a "trickle" and a "high". With it you can get everything that you want from a trickle charger. But, when your set has been in almost continuous operation for a number of hours and a trickle charger can't bring the battery back—then's when you'll need Rectigon most. For Rectigon's high charging rate will give the battery its full strength quickly and surely. Another change of the Rectigon leads and you recharge your wet "B"—*all with one charger, the Rectigon.* Also charges your automobile battery.

Westinghouse makes Rectigon—and Westinghouse knows radio. You remember when the first program came from KDKA—perhaps you're listening to Westinghouse radio every night now. Rectigon is simple and safe. It uses no acids or chemicals—has no moving parts to break or wear out. No harm done if you tune in while charging—none if the power goes off while Rectigon is in the circuit. For the cost of a few outside chargings, you can put Rectigon in your cabinet and forget the annoyance of weak or run-down batteries.

3 Ampere Rectigon
$1~~8.00~~
now
$14.00

5 Ampere Rectigon
$2~~8.00~~
now
$24.00

Westinghouse Rectigon

Battery Charger

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA.
Offices in All Principal Cities *Representatives Everywhere*
Tune in with KDKA—KYW—WBZ—WBZA

Rectox—for trickle charging only—will transform your wet "A" battery into a light-socket power unit. Replace your power every time you turn off the set. Rectox is trouble free—uses no acids or chemicals, has no moving parts. Adjustable to ½ or ¾-ampere charging rates.

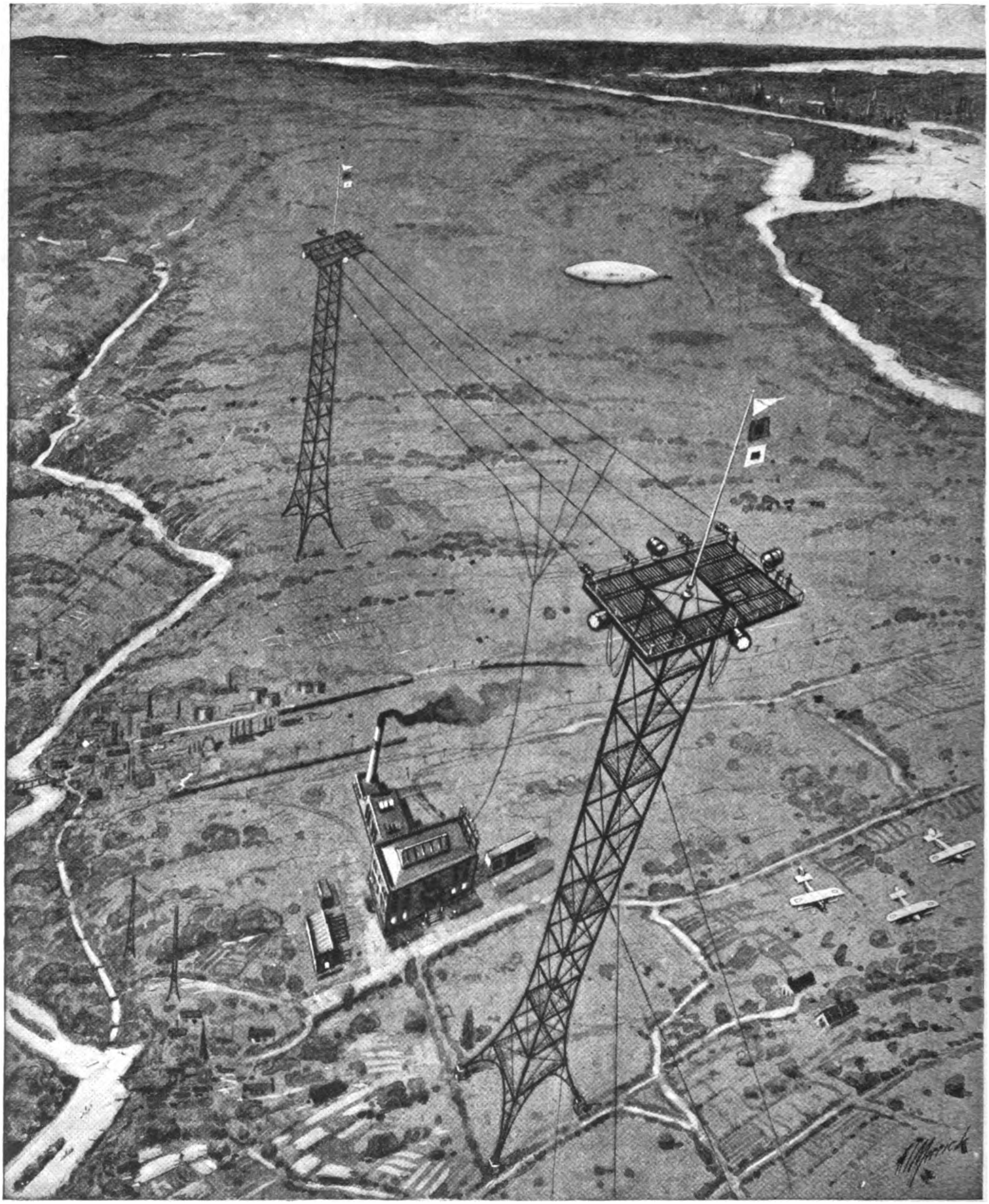
Besides Rectigon and Rectox for better battery charging, Westinghouse also makes Micarta panels and tubing for better insulation, and radio testing instruments for better reception.

Valuable to Engineer and Novice Alike

"POPULAR RADIO has always made a most cordial appeal to me. Its digest of all that is new and authentic in radio is accurate and scientific enough for the use of the professional engineer, and practical enough to meet the needs of the amateur."

H W Houck.

CHIEF ENGINEER,
DUBILIER CONDENSER CORP.



From a drawing made for POPULAR RADIO by Arthur Merrick

The 1,300 Horsepower Voices of Tomorrow's Broadcasting

When antennas sizzle with a million watts of broadcasting power, we may see such gigantic towers as these servicing the entire country with talent recruited from the nation's best artists. The station would have to be located a good distance from large cities, to prevent absolute "blanketing" of nearby receivers, and a power plant big enough to serve a fair-sized town would be necessary to supply electrical energy.

Popular Radio

VOLUME XII December, 1927 NUMBER 6

AND NOW ENGINEERS ARE PREDICTING

1,000,000-Watt Broadcasting

Time was when 5,000-watt transmitters were regarded as marvels of broadcast engineering. And now no less an authority than Dr. Goldsmith, the designer of the new 50,000-watt WEAF, answers the question, "How large can they build the broadcasters?" with predictions of the 1,000,000-watt broadcasters of the near future. And it is evident that we may look forward to the day when the ether of space will reel with the violence of still greater power!

By DR. ALFRED N. GOLDSMITH

IT is by no means self-evident at the present time whether the power that should be used by broadcasting stations to reach the listeners should be low or high. We have, however, now reached a point in broadcast development where we can take stock and endeavor to determine what trend in the use of power is desirable in broadcast transmission on a large scale.

It is assumed that stations of a non-speculative nature—that is, stations having as their serious purpose to supply acceptable programs to the community and to derive a reasonable return from such activities—are under consideration. Purely local stations, ultra-specialized stations and stations which are attempting to capitalize a possible temporary situation which permits inappropriately direct advertising to be broadcast at unsuitable hours, need not be considered in any discussion of the probable permanent trend of broadcasting.

To determine the trend of power in broadcasting involves a consideration of both the lower limit and the upper limit of the power of stations.

Unless a broadcasting station has what may be termed an "economic service area," it is not proceeding on a sound basis. The "service area" of a station can be defined in various ways. Perhaps as simple a definition as any is the area within which the station will give enjoyable program reception, day or night, winter or summer, except under unusually disturbed conditions, such as thunderstorms, local interference or the like.

Estimates of service range and area vary, depending upon the opinion of the originator of the estimate as to how much noise accompanying a program will be tolerated by the average listener. It has been estimated that in the eastern part of the United States, for the average listener in the city or suburbs, the service range of a 50-watt station is about 3 miles, of a 500-watt station about 10 miles, of a 5-kilowatt station 30 miles, and of a 50-kilowatt station about 100 miles.

Within the service area of a station there is an audience having a definite purchasing power for commodities advertised indirectly by the station (perhaps including radio receivers as well, even though these are not specifically mentioned). A station is commercially justified only if the annual purchasing power of the audience, averaged over all events given during a year, is great enough to justify the cost of the entertainment thus broadcast, both to the sponsors (advertisers) and to the broadcasting company itself.

In considering the lower limit of desirable transmitter power, the necessity for adequate service has been stressed. The service area is limited by interfering factors which injure the received signal quality. They include static (atmospheric disturbances), man-made electrical disturbances and, oddly enough, competing stations which by the attractiveness of their programs may draw the audience away from any given station. A successful broadcasting station, therefore, must produce adequate signal strength over considerable areas.

In general, 5 kilowatts is the present-day lower limit of power for stations of importance located outside of large cities. The location of stations within large cities is, in the present state of the art, to be regarded as inappropriate.

Turning to the question of the upper limit of broadcasting power, it is clear that the cost of a transmitting station will become excessive if transmitter power beyond a certain limit is used. The first cost of the station, and its maintenance (including the cost of electrical power), all force the broadcaster to consider seriously the use of no greater power than is necessary to justify the expense of the station.

Furthermore, the use of too high a power will lead to serious local interference, even in regions where the population density is not particularly high.

It might be thought, at first, that one could increase the service area of a station indefinitely by increasing the transmitter power. This, however, is not true, because at a distance of between 75 and 150 miles from the station fading of the signals begins to be a serious limitation of the quality of the service rendered by the station at such distances. A signal which fades in and out more or less irregularly obviously cannot be regarded as satisfactory to the average listener. Should fading be eliminated, the service range of stations might be extended beyond perhaps 100 or 150 miles, but it is doubtful whether, in the present state of our knowledge of radio wave propagation, any engineer will be justified in planning a station to have a greater service range than 100 or 150 miles.

On the other hand, if we aim at a 150-mile service range, sufficient power must be used at this inner edge of the fading zone to produce a signal of adequate intensity.

To be more specific is rather difficult at present, but for stations located within 50 miles of large cities the possible upper limit of power clearly lies between 50 and 500 kilowatts at present. On the other hand, for stations located at greater distances from large cities, and particularly in the western portion of the United States, a rough estimate of the upper limit of power is between 100 and 1,000 kilowatts.

We have, therefore, reached a point in broadcasting development where, in certain portions of this country, transmitter powers as high as 1,000 kilowatts may be considered as a possibility worthy of serious consideration. While this may come as something of a shock to those who once regarded one-half kilowatt as the maximum necessary power for broadcasting stations, yet the marked success of the 50-kilowatt station WGY has encouraged forward-looking engineers to plan further increases of power under suitable conditions in the future.

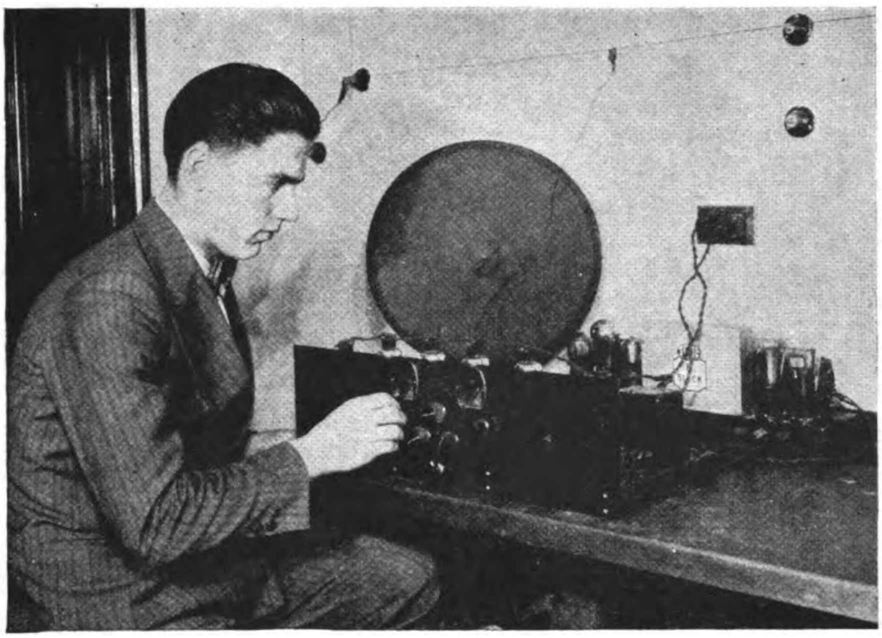
From the foregoing it is obvious that the general trend of power in broadcast transmitters is rapidly upwards. The power is being increased tenfold, on the average, about every three years. In

(*Continued on page 458*)

Radio Corporation of America

"WE ARE NOW ENTERING AN ERA OF REAL BROADCASTING"

Dr. Goldsmith, Chief Broadcast Engineer of the Radio Corporation of America, looks on beyond his achievement in designing the super-power station WEAF to the day when he will be called upon to design a 1,000,000-watt station.



There are no cumbersome batteries to run down, no trickle chargers to fuss with, no liquids to spill, in this setup, and the stations come in with the superb quality and volume of superheterodyne reception.

Simplified Socket Power with the New AC SUPERHETERODYNE

Radio engineering has at last made possible a receiver that has long been dreamed of by radio builders—a highly simplified superheterodyne incorporating all the desirable refinements of complete power operation from the lighting lines and the high selectivity, volume and tonal quality of heterodyne reception.

By ERNEST R. PFAFF

MANY experimenters and set builders have been deterred from building a receiver employing the superheterodyne principle by the mere fact of the usually high operating expense in "B" batteries and the "A" battery drain for so many valves.

The superheterodyne receiver necessarily employs a larger number of vacuum valves than most other standard circuits. The number of valves for use in such a circuit is an average of eight, although the superheterodyne principle has been used with as low as four and as high as fourteen vacuum valves.

This new superheterodyne, however, which uses AC valves throughout, entirely eliminates the problem of battery drain, as all of the power is drawn from the lighting lines and no batteries are needed, except a 4½-volt "C" battery, upon which there is little drain.

The new set is the first of its kind and operates admirably. It is built around the use of a high-wave amplifier originally designed for reception of time signals from the well-known Navy station at Arlington. The time-signal amplifier is manufactured complete, and contains the apparatus included in the dotted enclosure, F, in Figure 1.

It has been found that this amplifier performs admirably the functions of the intermediate amplifier ordinarily used in superheterodynes by merely adding an oscillator, shown in Figure 1 at J2, and a first detector, J1.

AC valves are used throughout the receiver; these are operated by the heater transformer at L, which operates direct from the 110-volt AC lighting line. This heater transformer also lights the two small pilot lights that tell whether the set is "on" or "off."

The set is built on the same idea as the LC-28 high-frequency pack, in that it includes no low-frequency amplifier, and should be used with a separate two-stage low-frequency amplifier. For this purpose the LC-28 Unipac is recommended, as the AC superheterodyne has been especially designed to work in conjunction with it.

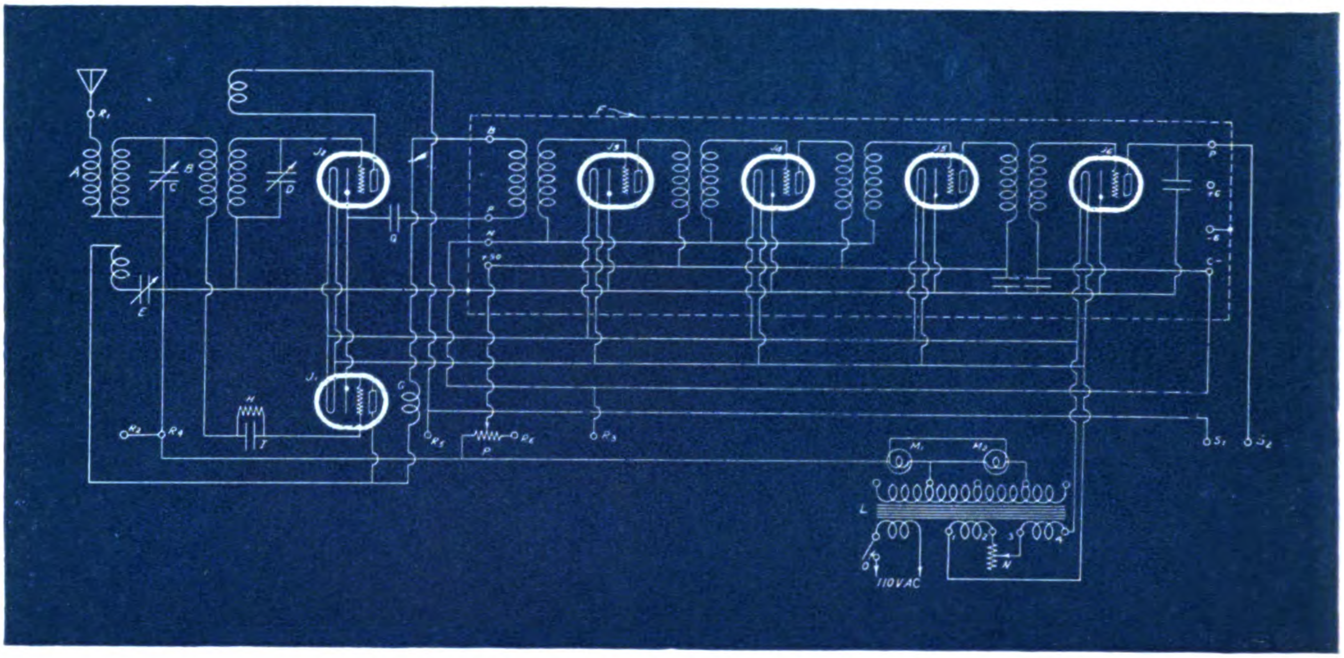
The LC-28 Unipac furnishes complete "B" voltages to this receiver and at the same time furnishes a power-operated amplifier of excellent quality that will make reception a pleasure.

How to Assemble the Instruments

The new receiver proper, which includes the intermediate-frequency pack in combination with a heater transformer for supplying the heating currents to the six Sovereign AC valves, is assembled upon a metal chassis with a metal front panel. All of the holes are drilled in these two units to fit exactly the instruments, parts, jacks and binding posts that go to make up the receiver.

It would probably be best first to assemble the instruments that are mounted on the metal chassis, U, shown in Figures 3 and 4.

Fasten down the two coils, A and B, the choke coil, G, and the two valve sockets, J1 and J2. Then attach to the metal chassis the condenser, Q, by flattening out one lug so that it screws directly into the hole in the chassis by



THE SCHEMATIC WIRING DIAGRAM OF THE RECEIVER

FIGURE 1: *This diagram shows the type of circuit employed in the new superheterodyne intermediate-frequency amplifier, F, and includes the first and second detectors and the oscillator circuit. A filament lighting transformer, L, is used to supply current for the heaters of the six vacuum valves*

means of a machine screw and nut. Next mount the heater transformer, L, by means of two bolts and nuts, in the position shown in Figure 3. The grid condenser, I, and the grid-leak, H, may next be mounted upon the grid terminal of the socket, J1, by bending over the small end of the lug of the grid-leak clip and screwing it tight underneath the screw terminal on the socket. The next job will be to mount the six binding posts, R1, R2, R3, R4, R5 and R6, along the back of the chassis, U, using the insulating washers that are furnished with the chassis to insulate the binding posts from the metal chassis, U. The ground binding post, too, may be fastened directly to the chassis, but without an insulating washer. Then mount the two tip jacks, S1 and S2, using insulating washers here to insulate them from the metal chassis.

Next mount the three-stage long-wave time-signal amplifier and detector unit, F, by means of four machine screws threaded up through the holes in the chassis and into the cover case of the unit. This will fasten it firmly.

After this the two metal windows for the dial controls may be fastened onto the front panel, T. At the same time fasten the two pilot lights, M1 and M2, in position, as shown in Figure 3. Four small machine screws and nuts are used in this operation.

Next mount the filament rheostat, N, and the gain-control, P, as well as the small variable condenser, E, on the front panel, as shown in Figure 3. The condenser, E, is fastened directly to the panel, but the two rheostats should be insulated from the panel with fiber washers.

After this has been done the two variable condensers should be attached to the mounting brackets of the drum dial, the drums attached to the condenser shaft and the whole assembly mounted on the front panel, with the control knobs fastened through the front panel. Next, fasten the front panel, T, to the metal chassis by means of eight machine screws, fastened through the panel and held tight with nuts on the inside of the metal chassis. When this is done the construction work is complete, except for mounting the switch, O, as shown in Figure 2.

The wiring may now be started.

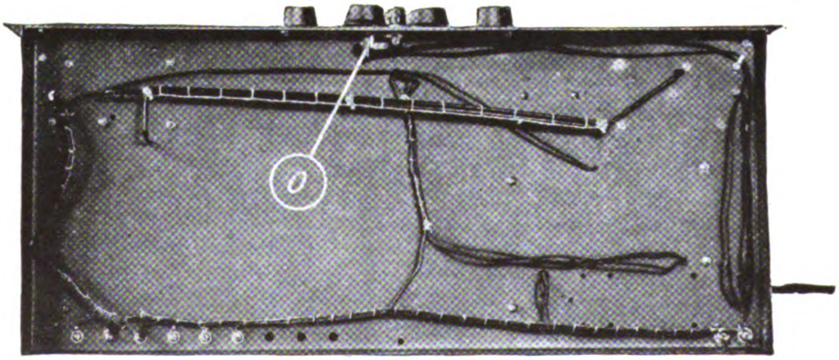
How to Wire the Receiver

By using a metal chassis which is grounded, many of the connections ordinarily necessary are done away with. All connections should be made with a braided insulated wire, such as Kellogg hook-up wire or Corwico Braidite.

If the wiring instructions, as shown clearly in the picture wiring diagram in Figure 4, are followed exactly, this job will be a simple affair. The wiring in this drawing is shown in blue, while the parts are outlined in black. Where the wiring runs underneath the metal chassis it is shown in dotted blue lines.

All of the wiring inside of the amplifier, F, is done by the manufacturer, and, of course, this has not been shown in the picture wiring diagram.

(*Continued on page 476*)

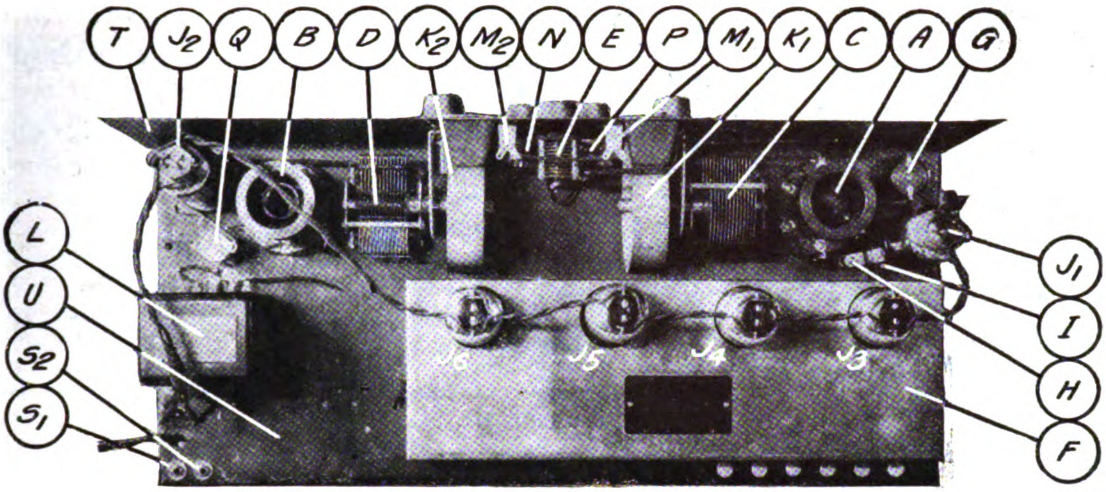


A VIEW OF THE SET FROM BENEATH

FIGURE 2: *Here is shown the under side of the metal chassis with the neat cable wiring completed. The switch, O, is the only unit mounted underneath the chassis*

POPULAR RADIO WORK SHEET

The New AC Superheterodyne



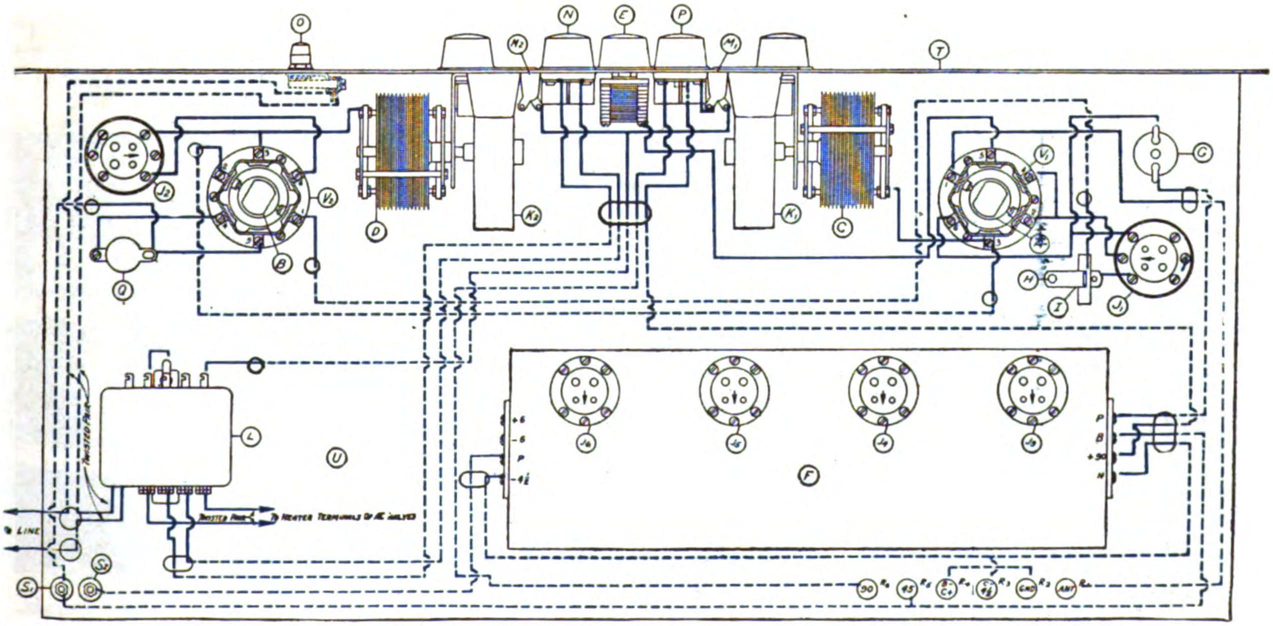
A TOP VIEW OF THE RECEIVER

Figure 3: *The shielded time-signal amplifier that is used for an intermediate-frequency amplifier is shown at the lower right; the filament transformer is at the left. Note the cable wiring for the heater circuits of the AC valves.*

List of Parts for Building This Receiver

Cost of Parts: *Not over $83.00*

A and B—S-M coils, No. 111A, equipped with S-M coil sockets, No. 515;
C and D—S-M variable condensers, No. 316B, .00035 mfd.;
E—S-M midget condenser, No. 342;
F—S-M time-signal amplifier, No. 440, 112 kilocycles;
G—S-M high-frequency choke coil, No. 275;
H—Carter grid condenser, .00015 mfd., with grid-leak clips;
I—Polymet grid-leak, 2 megohms;
J1, J2, J3, J4, J5 and J6—S-M vacuum valve sockets, No. 511 (only two required, as sockets J3, J4, J5 and J6 are part of the complete amplifier, F);
K1 and K2—S-M vernier drum dials, No. 805;
L—S-M filament lighting transformer, No. 325;
M1 and M2—Pilot lights that are furnished as part of the equipment with the No. 805 vernier drum dials;
N—Carter rheostat, type MW 1/5;
O—Carter power switch, No. 110;
P—Carter potentiometer, type MW-6,000;
Q—Carter fixed condenser, No. 105, .5 mfd.;
R1, R2, R3, R4, R5 and R6—X-L binding posts;
S1 and S2—Carter tip jacks, No. 10;
T and U—Van Doorn panel and chassis unit, drilled.



THE PICTURE WIRING DIAGRAM OF THE RECEIVER

Figure 4: *The instruments are outlined in* BLACK. *The wiring under the panel is shown in dotted* BLUE *lines, and the wiring above the panel in solid* BLUE *lines*

Radio "Spooks" All Over the House!

A VOICE FROM THE ETHER?

Suppose you were visiting a friend and spending the evening listening in on the radio. Suppose in the midst of the broadcast you should suddenly realize that a ghostly voice was coming from BENEATH *the chair in which you were comfortably ensconced. Well, whatever you thought, you would probably duplicate the attitude of the young man above.*

The mystery of the house of radio "spooks" is no mystery at all to the initiated, and with the information given here any radio fan should be able, with very little trouble, to mystify his friends and create endless amusement for himself during the long winter nights to come.

THE casual, unsuspecting visitor to this house of radio marvels sees practically nothing that would arouse his suspicions or that would lead him to believe that he was going to be the victim of radio trickery. A single loudspeaker of the cone type sits on the radio stand, and the genial host tunes in on one of the popular local stations. There is nothing unusual about the reception, save that it is good and that the volume is well above that afforded by the average radio receiver.

As the evening wears on, the guest quite suddenly realizes that the music is no longer coming from the visible speaker. It is just as sweet and as mellow and as entertaining, but the source of it has now become more or less perplexing. Now it seems to come from the roof; now from the living room, and now from the vicinity of the steam radiator. You can imagine how surprised a guest would be to suddenly realize that even the very chair he sits in is alive with vibrations. Sure enough, he is sitting on a loudspeaker!

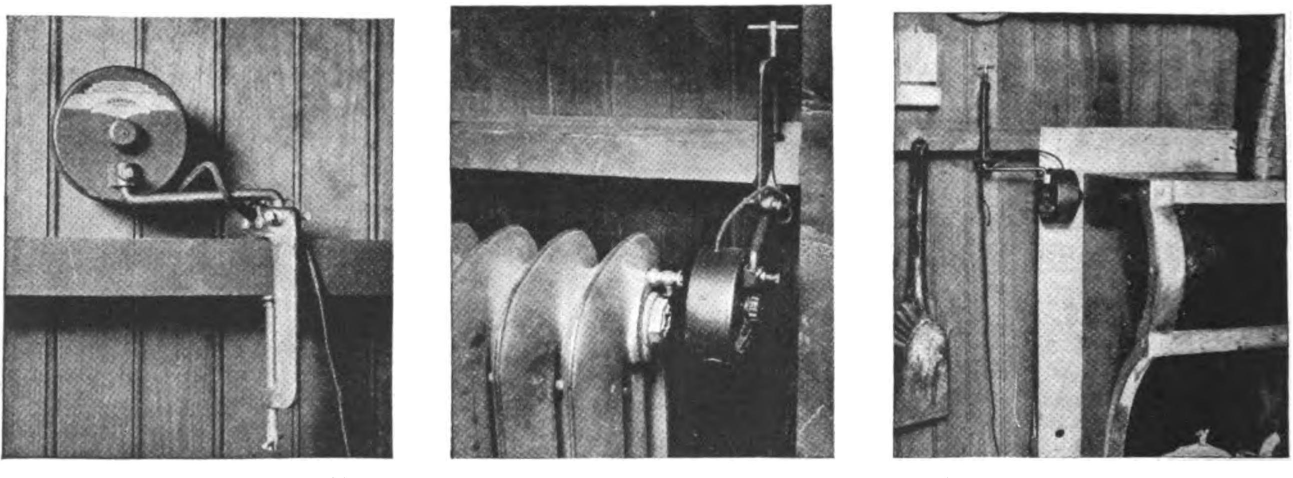
This last exciting experience actually makes Mr. Guest a little inquisitive, and this leads to a confession and demonstration, which is more or less startling. The host, who prefers to remain anonymous as far as the reader of POPULAR RADIO is concerned, claims that he has busied himself during the past year by making loudspeakers out of every conceivable household article.

The speaker unit is one sold under the trade name of INTERNATIONAL, and it was originally intended to be used in conjunction with the sounding board of a piano. The armature of this speaker protrudes through the case, and by the use of a special bracket this armature can be pressed against the surface with which it is to be used in contact.

Fourteen of these units were employed in the house of radio wonders, units being attached to such places as the sounding board of the piano, the wall of the room, the panel of the door, and behind a picture on the wall.

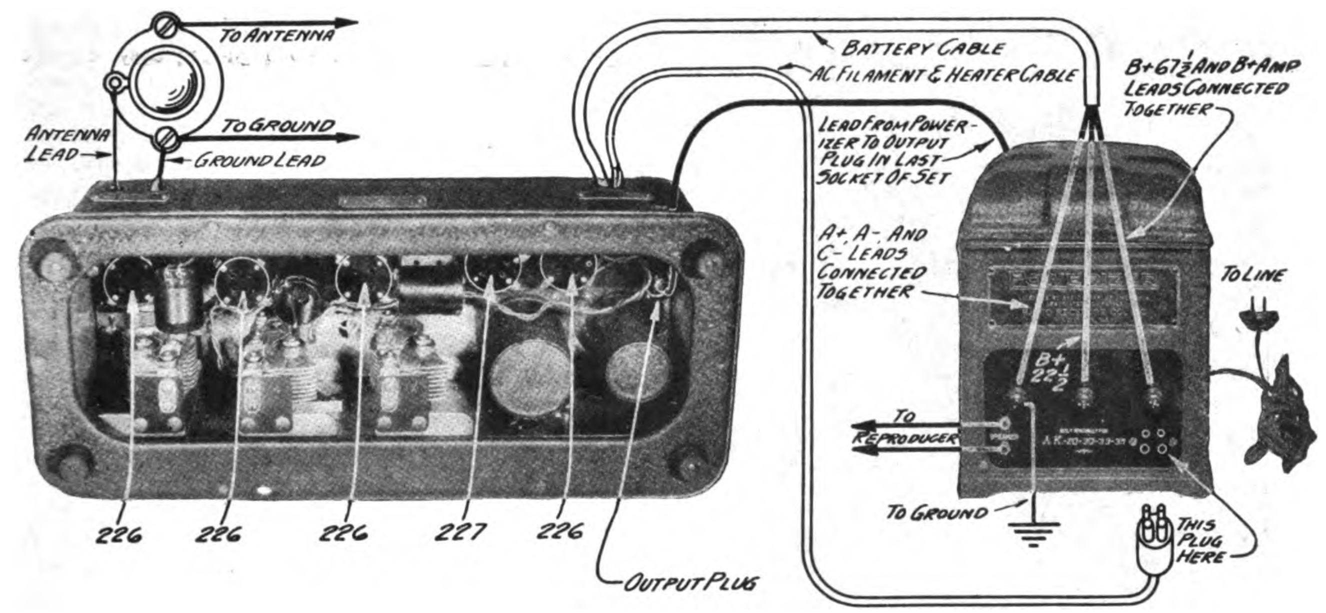
A rather amusing means of entertaining dinner guests was provided by attaching one of these units underneath the dining-room table. A still more ingenious application was that of applying the unit to the large panel at the head of the bed in the guest room. Mr. Arthur Bagley, the gentleman who conducts the health Tower exercises

(*Continued on page 494*)



THREE "VOICES" IN THE HOUSE OF RADIO "SPOOKS"

Here are three novel sounding boards for the reproducer unit that furnishes the voice of the radio ghost. At the left the unit is shown with its driving pin against a wooden wall partition. In the center it is clamped in such a position that its driving pin presses against a steam radiator. At the right the kitchen stove is being made to speak with the tongues of radio announcers. The ingenious fan needn't stop here, for any surface that can be made to vibrate at an audible frequency may be used as a sounding board.


TO ANTENNA
TO GROUND
ANTENNA LEAD
GROUND LEAD
BATTERY CABLE
AC FILAMENT & HEATER CABLE
B+67½ AND B+AMP LEADS CONNECTED TOGETHER
LEAD FROM POWERIZER TO OUTPUT PLUG IN LAST SOCKET OF SET
A+ A- AND C- LEADS CONNECTED TOGETHER
TO LINE
B+ 22½
TO REPRODUCER
TO GROUND
THIS PLUG HERE
226
226
226
227
226
OUTPUT PLUG

EASY TO INSTALL, EASIER TO OPERATE

Figure 1: *This illustration shows graphically all the changes necessary in installing socket power on the Atwater Kent model 35 receiver. The socket adapters and complete cable equipment for the connections indicated above come with the* POWERIZER.

NO MORE BATTERY WORRIES IF YOU INSTALL

Socket Power for Your Atwater Kent

This is the second of a series of articles that tell you how to bring your old receiver models up to date by providing them with complete AC operation from the lighting lines.

By CHARLES L. DAVIS

TO the thousands of people throughout the country who own Atwater Kent radios, the prospect of operating their receivers entirely from the light socket, without any of the worries attendant upon battery upkeep, will come as a long awaited boon. This is especially true of the installation described here, as the whole change-over operation, including the wiring of all of the AC valves and the hooking up of the special power-pack, is a matter of only a few minutes' work, and can be done by even the most inexperienced fan. The whole operation of making the AC installation on the Atwater Kent, model 35, 6-valve receiver is shown graphically in Figure 1.

The power-pack used is known as the POWERIZER, and is manufactured especially for Atwater Kent sets. With it is furnished a complete assembly of five socket adapters with a special heater cable that may be connected to the receiver in a few minutes. An output plug is also furnished for the last valve socket in the set for connecting to the 210 type power valve in the Powerizer. The standard battery cable furnished as part of the Atwater Kent set is connected to three binding posts on the connection panel of the Powerizer unit. The wires of this cable are to be grouped together as shown in Figure 1.

Four Ceco M-26 AC valves are to be placed in the socket adapter and, in turn, inserted in the first, second, third and fifth vacuum valve sockets in the set. Insert a Ceco N-27 valve in the fourth valve socket.

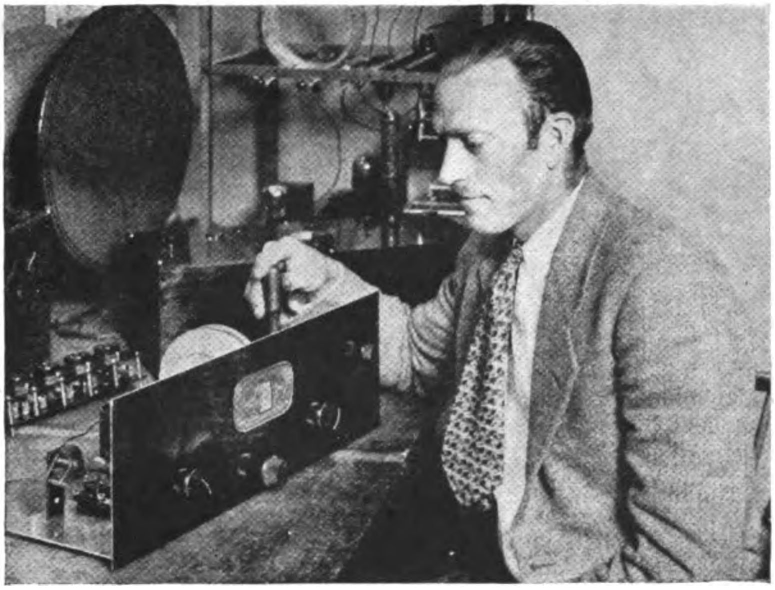
With AC operation, of course, it is imperative that a new volume control be installed on the receiver. This may be done on the receiver itself by following the instructions that come with the Powerizer, or the volume control may be installed externally in the antenna circuit. The volume control might be a 50,000-ohm potentiometer.

When the various connections have been made, as shown in Figure 1, the Powerizer may be installed underneath the set in the radio table or console, with the set on top, in its proper place. The power plug may be inserted in a lighting line socket and the unit completely controlled from the switch on the Powerizer. The Powerizer itself contains a complete power transformer, filter circuits, voltage dividers, all adjusted for the proper voltages and fixed, and a full-wave rectifier valve of the 280 type, as well as a power amplifier valve of the 210 type.

Once this installation has been made no further care or adjustment is necessary outside of handling the "on" and "off" switch. The set will tune exactly as before and the operation will be the same except that the new volume control is to be used instead of the old one.

The receiver will function with greatly added vigor and much improved tone quality, especially featuring the low notes of the orchestral accompaniments, and eliminating the overloaded distortion usually found in sets using only a small power valve.

In general, the results prove so satisfactory that every owner of this type of receiver should investigate the proposition so that he may more fully take advantage of modern broadcasting. Wide-awake radio dealers, as well as service men and professional set builders, will find in this new development an excellent and profitable opportunity to serve their clientele by improving reception conditions and eliminating the fuss and bother of battery replacement for themselves and their clients.



MR. GLENN BROWNING WITH HIS NEW PET

Few receivers have been more popular among set builders in the past than those designed by Messieurs Browning and Drake. Here is Mr. Browning with their latest creation, the work of a year's experiment, which promises to outdo even the splendid performances of the earlier models of their design.

WHEREIN MR. BROWNING TALKS ABOUT THE

1928 Browning-Drake

By GLENN BROWNING

THE Browning-Drake receiver, the outcome of the experimental work of Dr. Frederick Drake and the writer, was first introduced to the public some three years ago. Its popularity since that time has been steadily increasing and is due to the fact that the receiver is simple and inexpensive to build, but at the same time sensitive and selective. The low-frequency amplifiers specified with this receiver have always been of good quality, so that the results obtained were pleasing and satisfactory to the user.

Next month, in POPULAR RADIO, the writer will describe a new Browning-Drake receiver which is still easier to tune, still more sensitive, so as to cover greater distances, and still more selective, so as to cope with the congestion of present-day broadcasting. It also includes certain other refinements and improvements that will be of interest to Browning-Drake fans.

In the new set complete shielding is recommended, as it is essential to selectivity in such areas as Chicago and New York, and other congested localities.

The main feature of the new set will be an entire change in the neutralization system, using shunt-plate feed in order that standard 201-a type valves may be used in the high-frequency amplifier.

A further point of interest will be the use of either AC valves or standard valves in the new set.

In working out the new neutralization system, Dr. Drake and the writer spent a number of months in the laboratory trying out a number of neutralization systems, and finally decided upon the one to be described. In this system the high-frequency valve in the amplifier is fed by a parallel system so that no high-frequency current is able to pass through the "B" batteries or other "B" sources. This parallel feed system consists of a high-frequency choke and a condenser placed in the plate circuit, as shown in the diagram in Figure 1.

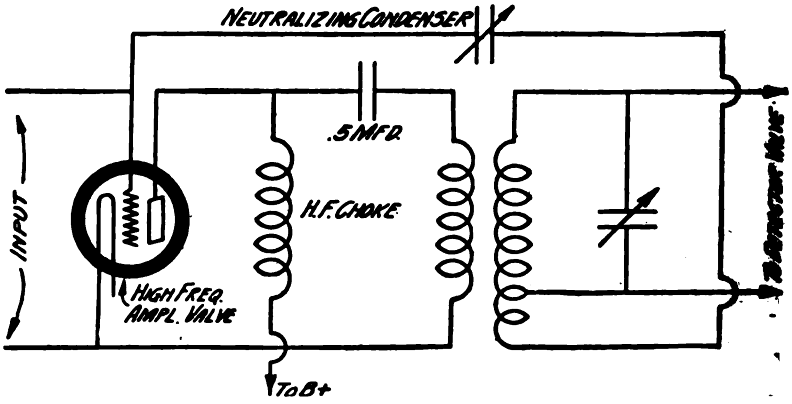
With this parallel feed system the neutralization is done by adding a differential coil onto the secondary of the high-frequency transformer, and by placing a small neutralizing condenser between the end of this coil and the grid of the previous valve, as shown in Figure 1. This system gives a practically perfect balance for the entire wavelength band, and this stability is partially due to the fact that no stray high-frequency currents are able to pass through the battery leads. The circuit is similar to a bridge. With the parallel feed system shown, including this neutralization scheme, a 201-a valve may be used as a high-frequency amplifier with improved results.

It will be remembered that in all previous Browning-Drake circuits a 199 type valve was recommended. The larger valve will give more amplification with added stability over the smaller valves.

The use of AC valves is becoming more general, and in the constructional article both AC and DC wiring diagrams of the new Browning-Drake set will be given.

The essential parts of this new receiver include the following:

1 Browning-Drake kit;
1 Browning-Drake foundation unit;
1 Browning-Drake shielding assembly;
1 AmerTran or Thordarson transformer;
2 Tobe fixed condensers, .1 mfd.;
1 Tobe fixed condenser, .001 mfd.;
1 Tobe grid condenser, .00007 mfd.;
2 Tobe resistors, .1 meg., 2 watts;
2 Tobe receivers, .25 meg., 2 watts;
2 Benjamin Cle-ra-tone vibrationless sockets.



THE NEUTRALIZING SYSTEM OF THE NEW RECEIVER

FIGURE 1: *The value of .5 mfd. for the fixed condenser in the above circuit was arrived at after careful study of Mr. Browning's and Dr. Chaffee's paper, "Detection," published in the* PROCEEDINGS *of the Institute of Radio Engineers. This value eliminates detection in the high-frequency amplifier circuit.*

New Researches Make Practical

RADIO ON TANKS

THE caterpillar tank would appear to be, through its very nature, a potential radio "dead spot." A radio receiver or transmitter operating within it is effectively shielded at all points of the compass by one half inch of armor plate, for the occupants must first be protected from bullets; and communication, although important, takes second place to safety.

A radio receiver used on a tank is not only electromagnetically sealed, but it is, at the same time, exposed to constant electrical interference produced by the spark plugs of an active gasoline motor. Still more difficulty is added by the clang and rattle of the tractors and the groan of the meshing gears, to say nothing of the din produced by the propelling motor. Conversation in a tank is almost impossible, let alone radio reception.

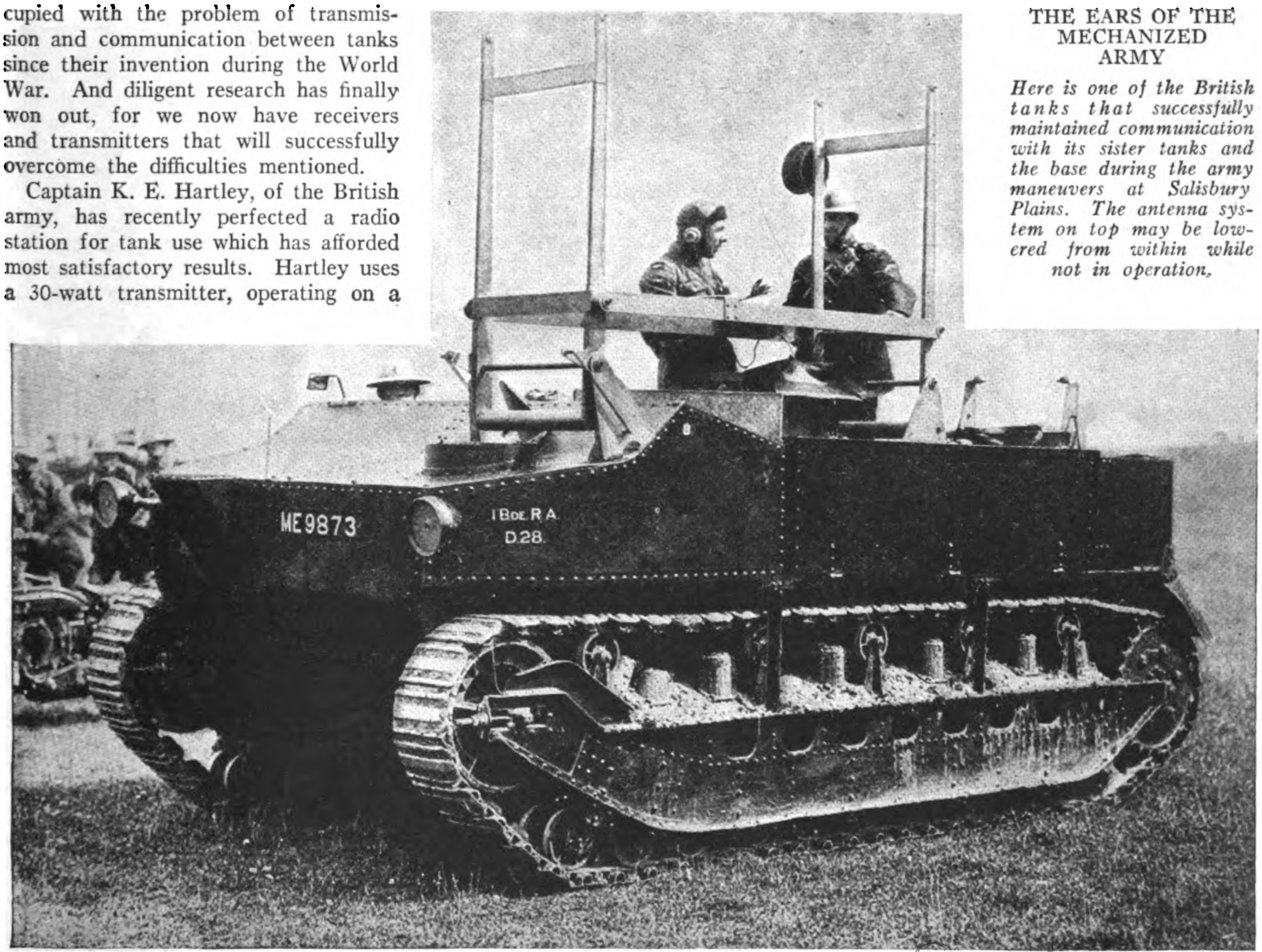
With all these adverse factors to thwart them, it is little wonder that radio engineers have been keenly occupied with the problem of transmission and communication between tanks since their invention during the World War. And diligent research has finally won out, for we now have receivers and transmitters that will successfully overcome the difficulties mentioned.

Captain K. E. Hartley, of the British army, has recently perfected a radio station for tank use which has afforded most satisfactory results. Hartley uses a 30-watt transmitter, operating on a short wavelength. Reception is accomplished with a special seven-tube superheterodyne containing only one stage of low-frequency amplification. This is used in conjunction with special padded headphones so constructed as to exclude practically all of the noise generated by the internal mechanism of the tank.

The aerial system of Captain Hartley's tank station is especially interesting. It is formed of hollow aluminum rods, so constructed that they may be raised and lowered as a unit, and the tank may proceed through restricted passages without danger of losing its ears and voice. The aerial is manipulated by means of a rod inside the tank.

During recent testing at Moulsford, England, triangle communication was established between two tanks six miles apart and a radio station twelve miles distant. This is considered a remarkable record for radio communication, under such extenuated circumstances, since a great deal of the energy of the signal is absorbed by the armor plate of the tank body. Proposals have been made for placing the transmitting and receiving equipment in a more advantageous position outside of the tank structure, but this has been objected to by army authorities because tanks are usually exposed to thick fire, and it is doubtful if the radio equipment would survive a single attack. A tank without radio equipment is left more or less floundering about with no form of communication with its sister units, or with the base.

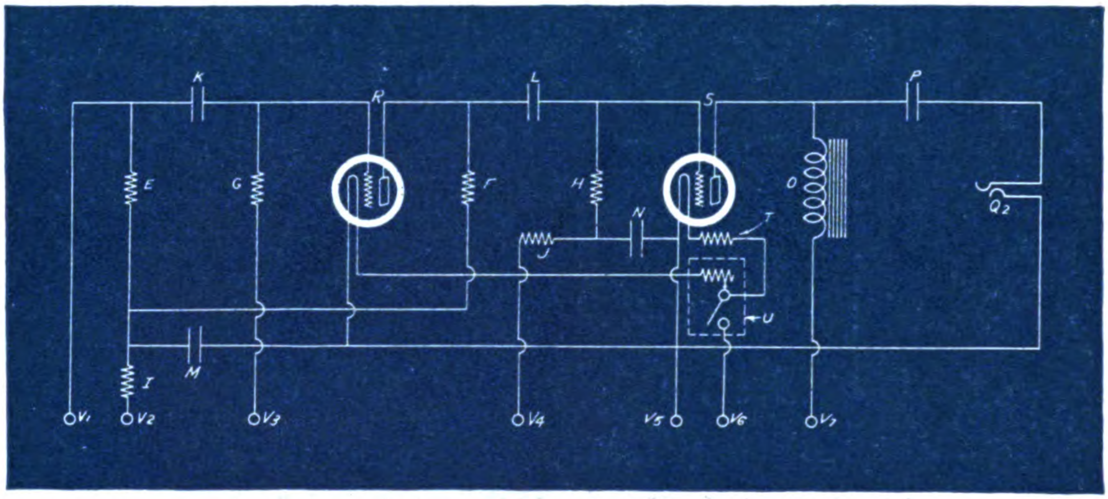
Radio engineers who have given special study to the problem of communication between tanks firmly believe that it may soon be possible to multiply greatly the range of receivers and transmitters, and make communication between tanks even more practical.



THE EARS OF THE MECHANIZED ARMY

Here is one of the British tanks that successfully maintained communication with its sister tanks and the base during the army maneuvers at Salisbury Plains. The antenna system on top may be lowered from within while not in operation.

Underwood & Underwood



THE SCHEMATIC CIRCUIT DIAGRAM OF THE AMPLIFIER

FIGURE 1: *The proper values for the grid-leaks and coupling condensers used in the circuit were arrived at by careful experiment on the part of the designer, Manfred Von Ardenne, and the extraordinary results obtainable with the unit are largely due to these evaluations.*

AN AMAZING DISCOVERY IN RESISTANCE-COUPLED AMPLIFIERS

Resistance-coupled amplification comes into its own in this astonishing low-frequency amplifier designed by Manfred Von Ardenne, the German experimenter, who is recognized as the outstanding authority on this type of amplification. Here are the constructional details for the amplifier, which may be constructed easily and cheaply from parts that may be obtained anywhere.

By ALBERT G. CRAIG

HERE is a new system of resistance coupling for low-frequency amplifiers. It was developed by Baron Manfred Von Ardenne and has come into wide use in his native Germany during the last few years.

During a visit to the POPULAR RADIO LABORATORY, Baron Von Ardenne outlined the theory of his new development. Briefly, the system uses high-mu valves, high values of plate resistance, comparatively small coupling condensers and high-resistance grid-leaks. The valves used have an amplification constant of approximately 30 and by the use of coupling resistances of 2 or 3 megohms an amplification (per stage) is attained which approaches the mu of the valve. By using a high value of grid-leak the coupling condenser can be quite small without having a large part of the voltage drop from the previous vacuum valve take place in it, rather than across the input of the succeeding valve where it is useful.

The amplifier to be described was built up shortly after Baron Von Ardenne visited POPULAR RADIO and has been thoroughly tested out in the Laboratory. It consists of two stages of resistance coupling and has an output filter for the power valve. Both Cunningham CX-340 and Radiotron UX-240 type valves were used for the detector and the first stage and a CX-371 or UX-171 type valve for the power valve.

The amplifier gives excellent quality of reproduction which is especially noticeable on the low notes, and has approximately the same volume as a two-stage transformer-coupled amplifier. It is cheap to build, as there are only two resistance-capacity coupling units and they use small condensers. A resistance-capacity filter has been incorporated in the "B" supply of the first two valves and in the "C" bias circuit of the last valve; these effectively prevent "motor-boating" when the amplifier is used on "B" power-packs. It might be said here that this is the system of amplification used in the German "multiplex" valves (see POPULAR RADIO for September, 1927), and it explains how a complete two-stage amplifier has been built into one glass bulb only slightly larger than the ordinary radio valve.

A schematic wiring diagram for the unit is shown in Figure 1.

How to Construct the Amplifier

To start building the amplifier, first cut the baseboard, W, to the proper size as shown in Figure 2. Then make the two small brass brackets, Y, of sufficient height to hold the binding-post strip one inch above the baseboard. Next cut the brass strap, Z, and bend it to fit over the condenser P, leaving two projecting lugs at the bottom with holes for the mounting screws.

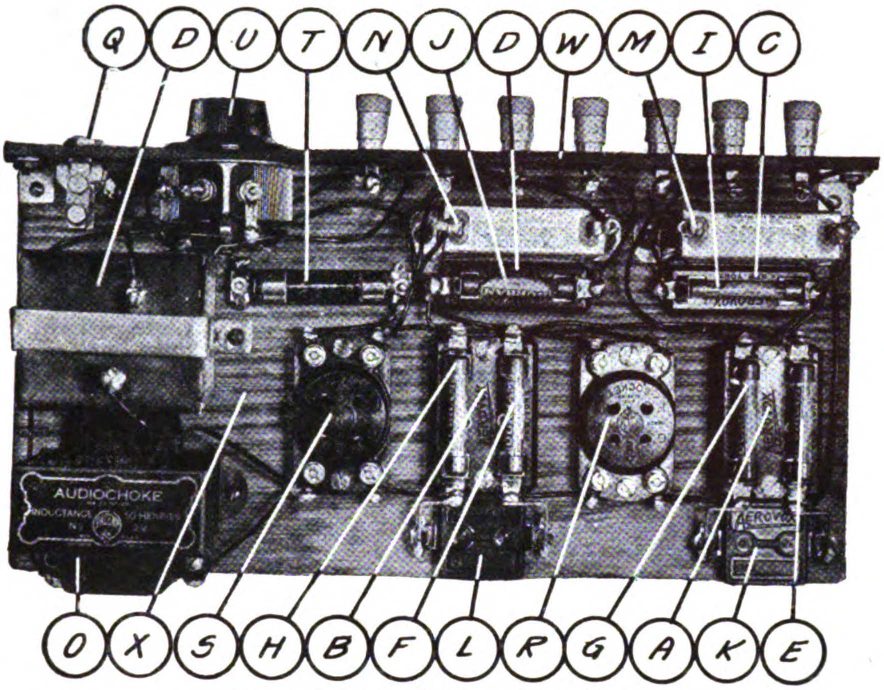
Now fasten the double mountings, A and B, in position with flat-head brass wood screws, noting that the "P" and "G" terminals are turned "away" from the binding-post strip.

Mount the sockets, R and S, with the "P" and "G" terminals "away" from the binding-post strip.

(Continued on page 452)

POPULAR RADIO WORK SHEET

THE VON ARDENNE AMPLIFIER



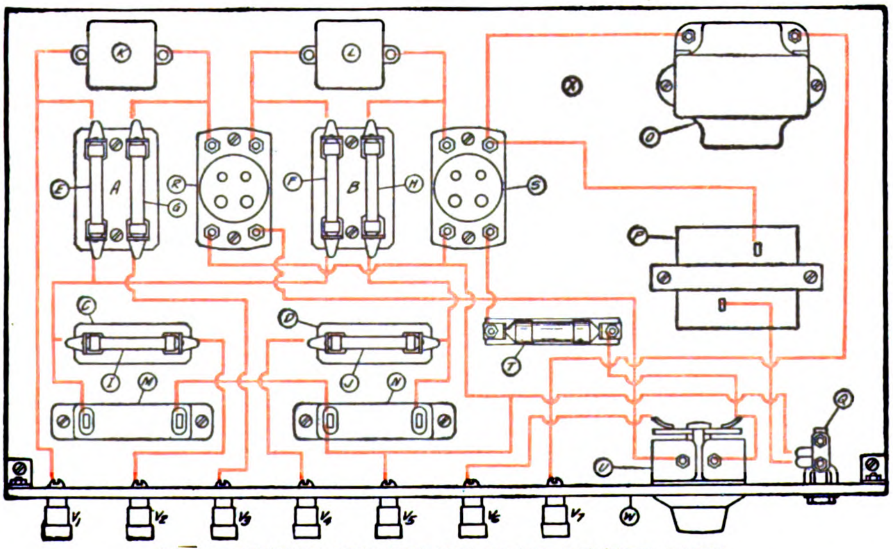
A VIEW OF THE AMPLIFIER FROM ABOVE

FIGURE 2: *Note the compact arrangement of the instruments in the new* ***amplifier.***

LIST OF PARTS NECESSARY FOR BUILDING THIS UNIT

COST OF PARTS—*Not over $26.00*

A and B—Aerovox double mountings. type 1050;
C and D—Aerovox single mountings, type 1049;
E and F—Durham standard metallized resistors, 2 megohms;
G—Durham standard metallized resistor, 8 megohms;
H—Durham standard metallized resistor, 6 megohms;
I and J—Durham standard metallized resistors, .5 megohm;
K and L—Aerovox mica condensers, type 1450 (moulded in bakelite), .006 mfd. capacity;
M and N—Dubilier condensers (DC working voltage 160), type 907, 1 mfd. capacity;
O—Pacent shielded low-frequency choke, No. 29;
P—Dubilier fixed condenser (DC working voltage 400), type 902, 4 mfd. capacity;
Q—Frost open-circuit "Gem" jack, No 953;
R and S—Pacent sockets, No. 83;
T—Amperite No. 112, ½ ampere;
U—Frost metal frame, 20-ohm rheostat with switch No. S-1720;
V1, V2, V3, V4, V5, V6 and V7—XL push posts;
W—Baseboard, 6 by 12 by ½ inch;
X—Bakelite binding-post strip, 1 by 12 by 3/16 inch;
Y—Brass brackets for supporting binding-post strip;
Z—Brass strap for mounting condenser P;
Wire, screws, solder, etc.



THE PICTURE WIRING DIAGRAM OF THE UNIT

FIGURE 3: *The instruments are outlined in* BLACK *lines and the wiring is indicated in* RED *lines.*

TUNING WITH A PUSH BUTTON

In this ingenious system of automatic tuning, which may be incorporated in any receiver, POPULAR RADIO *sees a near future in which radio reception will be as effortless and as pleasurable as modern science can produce.*

By ELMER E. BURNS*

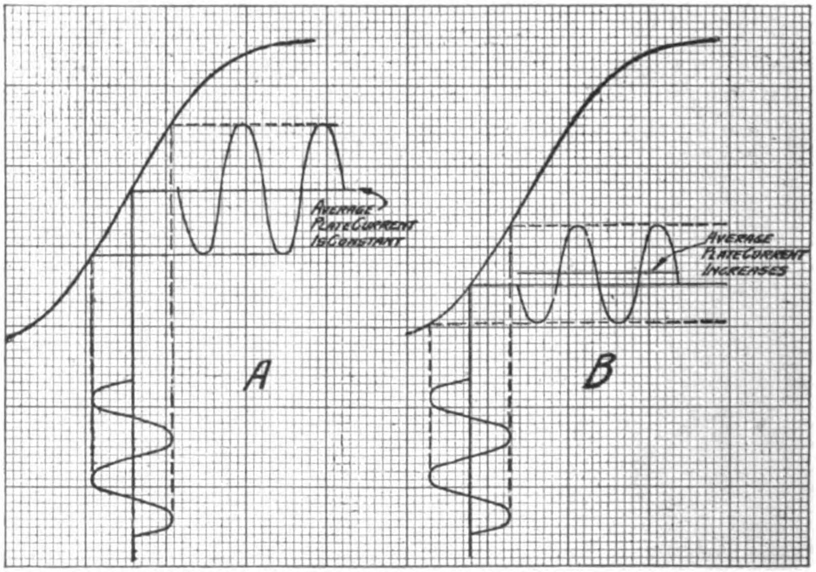
THE problem of automatic tuning is essentially that of taking advantage of some effect that takes place in a radio receiver at a point of resonance to control the action of the tuning unit. The only changes that appear to offer possibilities in this direction are: (1) High-frequency oscillations in the antenna circuit, (2) voltage variations across the inductances and capacities of the receiver, and (3) variations in plate current.

In the self-tuner which my co-worker, Mr. Theodore Cohen, and I designed, we took advantage of two effects mentioned above; namely, voltage and plate current variations.

The practical self-tuner to apply to the present-day receiver must have these characteristics:

First, the moving part of the tuning unit must be turned at about the same rate as it would be turned in tuning by hand. It should be capable of being set in motion by the simple operation of pressing an ordinary push button. Second, when the tuning unit is brought into resonance with received signals, the moving part must stop automatically. If it is necessary to stop the moving element by any manual op-

(*Continued on page 478*)

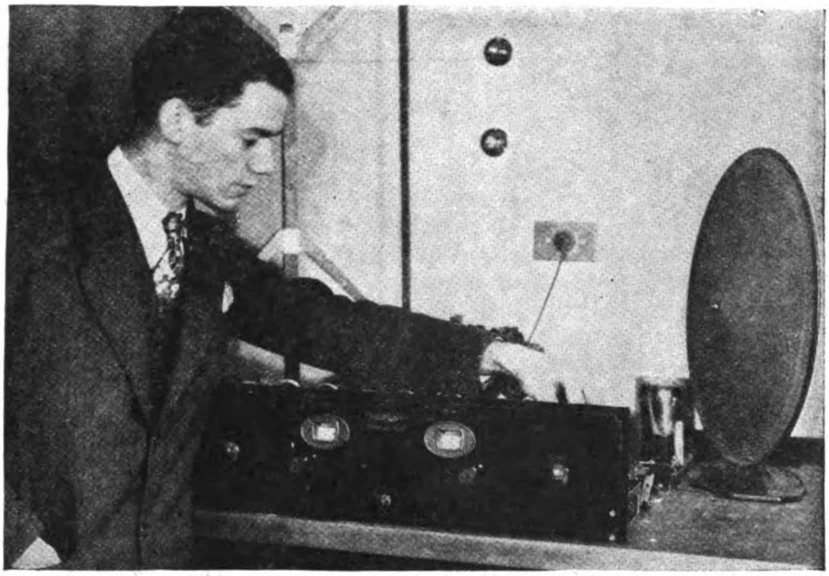


HOW THE VALVE OPERATES THE RELAY

FIGURE 1: *At the left is shown a characteristic curve of a vacuum valve operated at the mid-point of the straight portion of the curve. An incoming signal produces no change in the average plate current under this combination. At B is shown a characteristic curve with the vacuum valve operating on the non-linear portion of the curve, so that an incoming signal produces an increase in the average plate current that may be used to operate a relay.*

---

*Elmer E. Burns is a teacher of physics in the Austin High School, Chicago, Ill. Those who wish to communicate with him about his novel system of automatic tuning should address letters to 3515 Home Ave., Berwyn, Ill.



ADJUSTING THE RHEOSTATS

The rheostats mounted on the sub-panel of the Magnaformer receiver are more or less critical in their adjustment, and the best results from this receiver are obtained only when they have been set at the proper point for efficient operation.

FOLLOW THESE "GOLDEN RULES" WHEN

Operating the Magnaformer

Best results with superheterodyne receivers always come with careful adjustment of the operating voltages, and although the Magnaformer 9-8 in its operation is one of the simplest receivers ever designed, it can be made to live up to all of its many splendid possibilities if the operating data given in this article is followed.

By WILLIAM STEINKE

AFTER a more or less complex receiver has been constructed and put into operation, even the experienced radio fan frequently wonders whether he is operating the receiver properly. In the case of the Magnaformer 9-8 receiver there are three rheostats which might be puzzling to the builder. Two of these may be set once and thereafter require no attention. They are located in the receiver, on the sub-panel. In making the original adjustment, the rheostat which controls the second detector filament should come in for first attention. This rheostat is not critical and its adjustment is easy. With all rheostats set at the half-way point, tune in any station that happens to be on the air. Then vary the potentiometer, G, to reduce the signal volume so that it is just loud enough for comfortable audibility. Then adjust the second detector rheostat, I, by turning its knob to the lowest setting that will give maximum volume. This is probably best done by turning it all the way "on" for an instant and then turning it back in an anti-clockwise direction until the volume of reproduction starts to diminish. Just above this point is the proper setting for this control. With a standard valve this point will usually be with the rheostat about half-way "on."

In adjusting the rheostat, H, in Figure 1, which controls the filaments of the oscillator and the first detector valves, it is advisable first to tune in a distant station. This rheostat is somewhat more critical in adjustment than is the one described above. Also, the adjustment that provides the best reception of distant stations will not necessarily be the best adjustment for local reception. The real purpose of this rheostat is to regulate the strength of the oscillator or heterodyne current by varying the filament supply to the oscillator valve.

For best reception, the oscillator current should be weak for weak signals from distant stations and stronger for strong signals. However, there is no need to worry about "best" reception in the case of strong local stations, because this receiver is capable of such tremendous volume that there is more than ample for all practical purposes, even if the oscillator current is comparatively weak.

Turn the potentiometer knob, G, in Figure 1, which controls volume, to a point just below that where oscillation starts, and adjust the two tuning controls, O1 and O2, very carefully to the point of maximum response. Then increase the setting of the oscillator rheostat knob, H, to a point slightly above half way. The potentiometer and tuning controls should then be readjusted to make sure that they are still set for maximum, for the alteration of the filament current of the oscillator and first detector may throw them off slightly. Continue this process at several different adjustments of the oscillator rheostat until the one is found that provides best reception, remembering always to readjust the volume and tuning controls after each change in the oscillator rheostat setting.

With the two rheostats, H and I, on the sub-panel adjusted properly, they may be forgotten as long as the "A" battery is kept up to normal charge and the same valves are kept in use in the oscillator and the two detector sockets. Any changes in these valves may require readjustment, particularly if the new valves be of a different make or type than those used during the original adjustments.

The filament control, F, on the front panel governs the current supply to the four intermediate-frequency amplifier valves. Its adjustment also effects the volume. The best adjustment for this rheostat, F, is obtained by varying the volume control at the same time, always keeping the amplifier just under the point of oscillation, as was done in adjusting the oscillator rheostat.

It will be found that all of the seven valves controlled by the rheostats in this receiver will operate as well or better at slightly subnormal voltages than at normal ratings. It is worth while, then, to keep the rheostat settings at the lowest points that give best results, because in this way the current drain on the storage "A" battery will be considerably below that normally required for a receiver using this number of valves.

How to Tune the Receiver

The Magnaformer 9-8 receiver has one very important feature which few other superheterodyne receivers have. It lies in the fact that the tuning controls tune alike. In the operating test made on one of these receivers at the Popular Radio Laboratory the difference between the settings of the two dials for any given station did not exceed one division—and this corresponds to a half degree on other receivers, inasmuch as the dials used in the Magnaformer receiver are calibrated in 200 divisions rather than in the 100 divisions of the ordinary receiver dial.

In addition to the ease of tuning and of logging stations with this arrangement, it has the advantage that there is less trouble with repeat points.

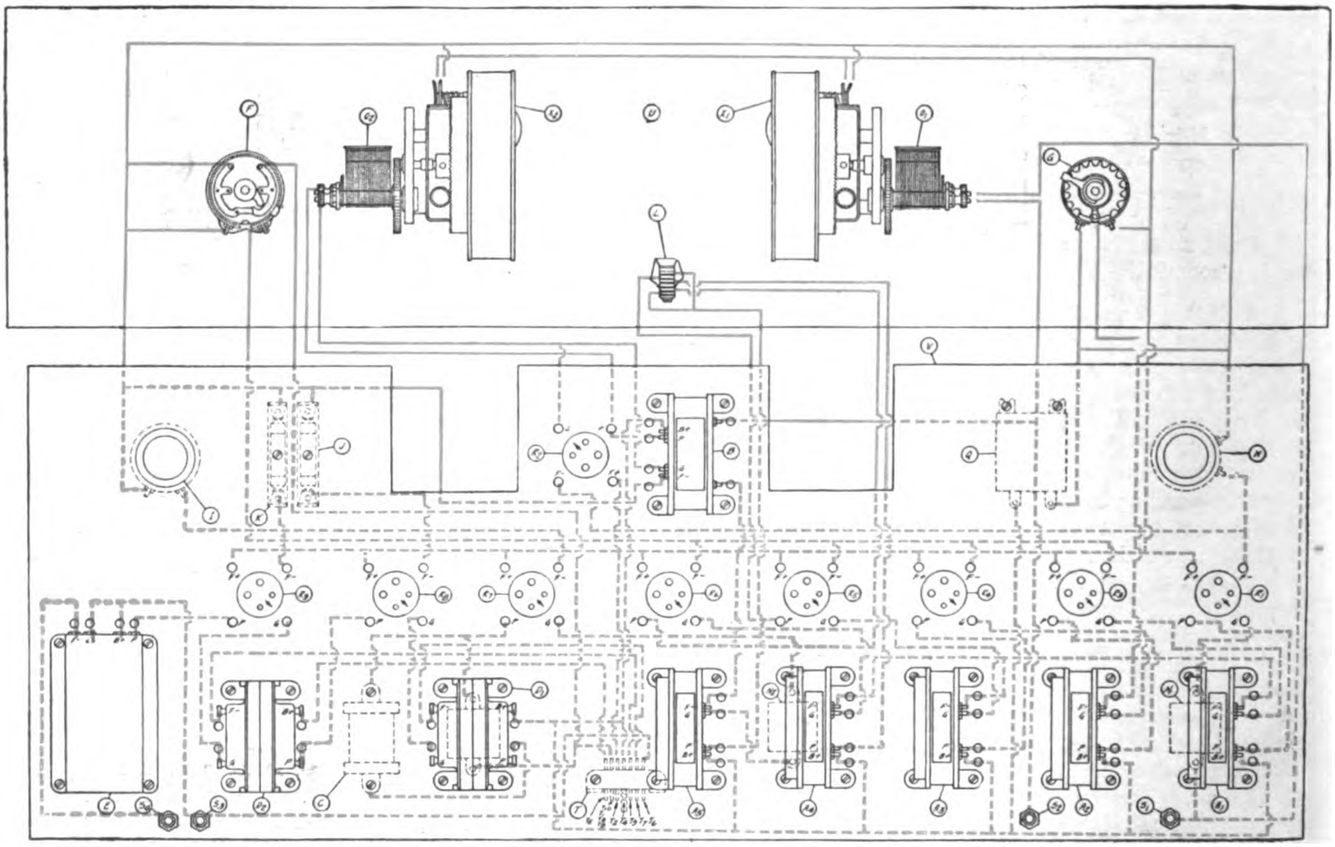
In tuning for distant stations there are two plans that may be followed. The first and best plan is to turn the volume control up until the intermediate amplifier is just below the point of oscillation. Then turn the two tuning controls in unison. When the carrier of a station is encountered, it will be indicated by a rushing sound. A slight readjustment of the dials to exact resonance will bring the signals in. It must be borne in mind that the tuning is extremely sharp in the case of distant stations and for that reason the dials should be turned slowly when "fishing" for distance.

The second plan of tuning weak signals is to turn the volume control just beyond the point of oscillation. Then, when the right-hand (oscillator) dial is tuned to a station's carrier wave, a "birdie" whistle will be heard. This whistle will increase in intensity as the loop dial is brought into resonance. Then, if the potentiometer knob is turned back slightly below the oscillation point the signals will be heard.

Adding Regeneration in the Magnaformer Loop Circuit

There are many fans who prefer to use a small amount of regeneration in the first detector circuit of a superheterodyne receiver. In the case of many supers this is quite necessary if good sensitivity and adequate selectiv-

(*Continued on page 474*)



THE REVISED HOOK-UP FOR THE MAGNAFORMER

FIGURE 1: *This is the revised and official picture wiring diagram for the Magnaformer receiver that produces such wonderful results when operated on a loop. The instruments are outlined in* BLACK *and the wiring is shown in* RED. *The dotted* RED *lines indicate that portion of the wiring that is to be connected underneath the sub-panel.*

INTERFERENCE

What Kind of a Noise Have You Been Hunting For?

Every radio fan can be his own interference detective, providing he understands the criminal record of some of the most flagrant breakers of radio peace and quiet. Radio noises are usually classified and recognized by the type of sound produced in a loudspeaker. Below will be found notes pertaining to the sounds produced by electrical appliances of various types. Perhaps the first thing to do in tracing interference is to check up the electric light sockets of the house to see that there are no loose connections. Just tapping the fixtures is sufficient to reveal any trouble.

1

1: *An irregular noise in the form of a series of sharp clicks coming close together is sometimes caused by sparking commutators on DC fans. An adjustment of the brushes and cleaning of the commutator is the remedy.*

2

2: *Percolators with thermostatic controls produce a distinct click in the speaker every time the automatic cut-out device functions. There is really no remedy for this, unless the household wants to go without coffee.*

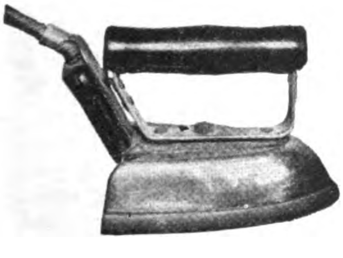
3

3: *A loose connection in an electric toaster will cause especially heavy clicks of an aperiodic nature in the speaker. If the toaster is jiggled while in operation, this trouble may be located.*

4

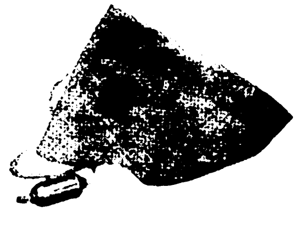
4: *An AC induction motor will produce a click in the speaker only when it is coming to full speed. Commutator motors of all sorts will produce roars if the brushes are poorly adjusted.*

5



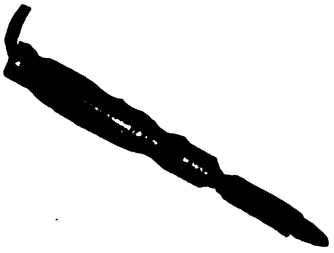
5: *Two things in electric irons cause interference—loose connections and automatic thermostatic regulators. There will be a loud click in the speaker when the thermostatic control functions.*

6



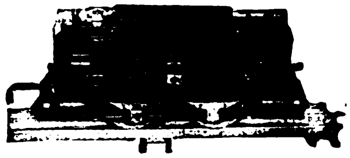
6: *Heating pads are usually controlled with a thermostat which produces clicks in the speaker. Cases are known where loose connections in pads have disturbed reception in an entire community.*

7



7: *Soldering irons become offenders only when loose connections occur in the flexible cable. Any heavy current device causes severe interference when a loose connection is present.*

8



8: *Toy trains cause interference through sparking commutators on the motor, and through sparking rails. The motor interference can be eliminated, but there is practically no remedy for the sparking rail.*

Here Are the Facts About the Latest Discovery in Radio—

The Octa-monic Circuit

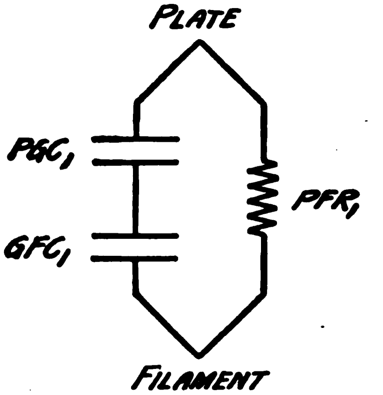
No really new radio circuits? If you think so, read this description of the Octa-monic circuit—a circuit that is fundamentally different from all that have gone before. It works on a principle opposed to that of the superheterodyne, in that detection takes place at a higher frequency, rather than a lower frequency, than that of the incoming signal. The advantages of this system are here described by—

JOHN BRENNAN

A COMPARISON of the standard type of ordinary tuned-high-frequency circuit with the Octa-monic circuit reveals some interesting points regarding the relative losses in these two types of circuits.

The electrical characteristics of a tuned-high-frequency circuit are shown in Figure 2. The high-frequency valve characteristics can be denoted electrically as two condensers, "GFC1" and "PGC1," in series for vacuum valve No. 1. These condensers represent the grid-to-filament capacity and the plate-to-grid capacity between the elements of the valve. The resistance "PFR1" represents the plate-to-filament resistance of the valve. We therefore have an equivalent electrical circuit as shown in Figure 1.

This circuit consists of a resistance "PFR1," connected in parallel with two series condensers, "PGC1" and "PFC1." It can therefore be seen that there are two paths for the signal energy through the elements of the vacuum valve, one through the capacity leg and the other through the resistance leg. At ordinary broadcast frequencies, the series condenser path offers a large resistance that may run as high as hundreds of times that of the resistance path. This latter path, or, in other words, the plate impedance, is therefore an important factor in the plate circuit of high-frequency amplifiers. The same conditions that exist in valve No. 1 also exist in valve No. 2; so we have, in the ordinary two-stage circuit, two circuits which at ordinary broadcast frequencies may add considerable resistance and may tend to broaden the tuning unless these effects are carefully accounted for.



A SCHEMATIC REPRESENTATION OF A VACUUM VALVE

FIGURE 1: *The electric characteristics of a vacuum valve in a high-frequency circuit may be considered as consisting of two capacities in series with a parallel resistance.*

In the Octa-monic arrangement, also shown in Figure 2, we have only one plate circuit to consider, so that the effect of broadened tuning from plate circuit dampening is very remote.

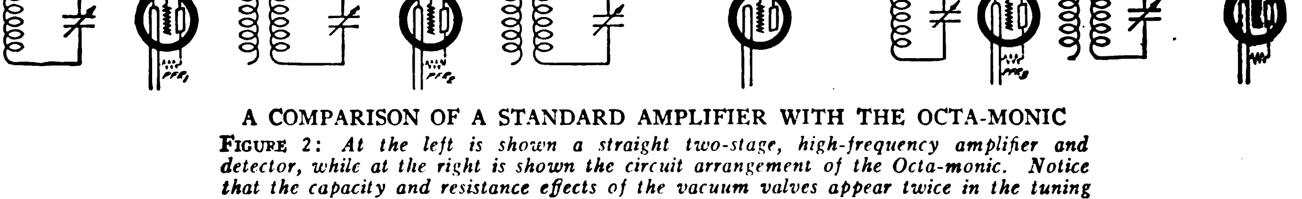
In actual practice, the tendency toward any broadness in tuning is further reduced by the peculiar action of the valve when working at double the frequency of the incoming signal.

It is this absence of resistance damping in the Octa-monic that produces, in the grid circuit of the detector, a resonance curve that is sharper than the resonance curve produced in the detector circuit by a single stage of tuned-high-frequency amplification. The remarkable part of this feature is that this increased selectivity is accomplished in the Octa-monic with one less stage of amplification.

It is also interesting to note that this selectivity is obtained in the Octa-monic without sacrifice of tone quality. Instead of cutting off any side-bands as a result of increasing sharpness, the fact that the Octa-monic operates at double the frequency of the incoming signal increases the frequency separation and permits the use of a wider side-band range in spite of the sharper tuning.

The effect of side-bands on quality and the limitations they impose on selectivity is an interesting study. A consideration of their importance will therefore prove of value.

A transmitting station broadcasts only one frequency or wavelength when there is no music or speech being put on the air. This frequency or wavelength is known as the "carrier wave" (shown in Figure 3). As soon as the program starts, the speech and tone frequencies of voice and instruments are superimposed on the carrier frequency, changing the carrier frequency to a composite form and increasing the frequency range according to the



A COMPARISON OF A STANDARD AMPLIFIER WITH THE OCTA-MONIC

FIGURE 2: *At the left is shown a straight two-stage, high-frequency amplifier and detector, while at the right is shown the circuit arrangement of the Octa-monic. Notice that the capacity and resistance effects of the vacuum valves appear twice in the tuning circuits of the standard amplifier and only once in the Octa-monic.*

heterodyne or "beat-note" principle.

In radio telephony there are two important beat frequencies produced for each tone or frequency which is superimposed upon the carrier wave. This means that when a broadcasting station is transmitting music which ranges in frequency from a few cycles per second up to 5,000 cycles per second, a band of frequencies 5,000 cycles wide each side of the main carrier wave frequency will thus be utilized for the transmission of sounds. In other words, a broadcasting station requires a frequency band having a width of at least 10,000 cycles or 10 kilocycles when transmitting music.

If we investigate the conditions present in the matter of separation of two broadcasting stations operating at 10 kilocycles apart we will discover an interesting difference between the ordinary tuned-high-frequency receiver and the Octa-monic.

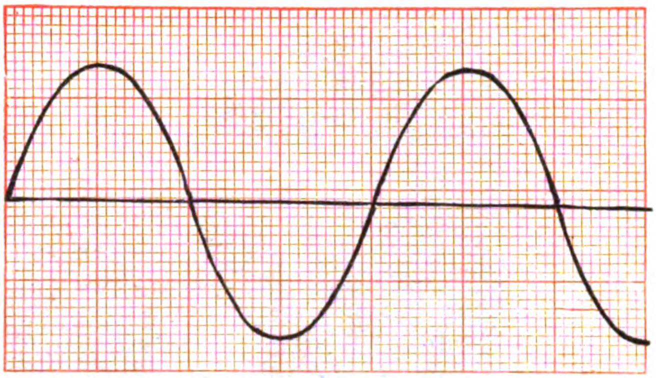
Let us take, for instance, a station transmitting on a frequency of 600 kilocycles (500 meters) and a station operating at 610 kilocycles—a separation of 10 kilocycles.

The side-bands of the 600-kilocycle station will range from 595 kilocycles to 605 kilocycles, while those of the 610-kilocycle station will range from 605 kilyocycles to 615 kilocycles, i. e., 5 kilocycles on either side of the carrier frequency. It will be seen that these two stations may sometimes be operating on practically the same frequency, or on frequencies which may overlap, viz., on 605 kilocycles. The result will naturally be interference or heterodyne whistling. To avoid interference it is necessary to tune the circuits sharply so as to limit the side-bands, and this limiting may result in the loss of some of the tone frequencies, with a consequent loss of quality.

In the Octa-monic system, on the other hand, we have an entirely different set of conditions. Since amplification takes place at double the frequency of the incoming wave, the frequency of the 600 kilocycle wave is shifted by the action of the vacuum valve detector to 1200 kilocycles, while the frequency of the 610 kilocycle wave is shifted to 1220 kilocycles.

A variation of 5 kilocycles on either side of the 1200 kilocycle wave will give a range of from 1195 to 1205 kilocycles, while the same variation on either side of the 1220 kilocycle wave will give a variation of from 1215 to 1225 kilocycles.

There is, therefore, an open space between 1205 and 1215 of ten kilocycles which allows for sharper tuning without sacrificing any of the side-bands.



A CARRIER WAVE

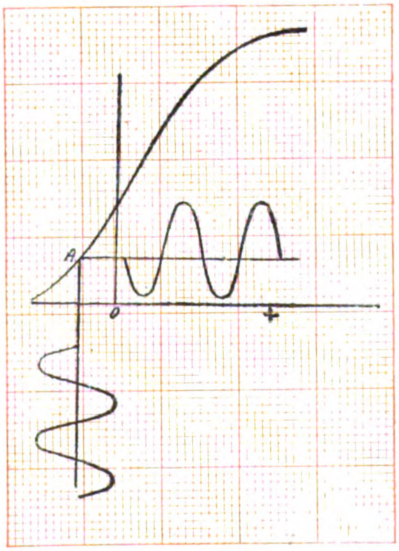
FIGURE 3: *This is a diagram of the continuous alternating-current wave generated by a transmitting station. On this wave are superimposed the audible frequencies that compose the broadcast sounds.*

This accounts for the fact that the Octa-monic system can be tuned sharper than the tuned-high-frequency type of circuit without sacrificing the quality-giving side-bands.

In the superheterodyne, on the other hand, where amplification takes place at a lower frequency (higher wavelength) the opposite holds true, so that in the case of the superheterodyne, the side-bands may be sacrificed in obtaining super-selectivity, thus resulting in impaired quality of reproduction.

The generation of harmonics in vacuum valves, the principle of which is the basis of amplification at double the frequency of the incoming wave, constitutes a special field for design, because for that purpose the valve is operated on a different part of the characteristic curve than that employed in amplifiers or in grid-leak detectors.

Figure 4 shows the characteristic curve of the ordinary vacuum valve. In order to function as a second harmonic generator (double frequency producer), the grid must be operated at about point "A" on the curve, so as to produce unequal amplification in the fundamental carrier wave. The positive half of each wave is amplified more than the negative half.



THE CHARACTERISTIC CURVE OF THE OCTA-MONIC DETECTOR

FIGURE 4: *This diagram shows the characteristic curve of a vacuum valve detector and illustrates the point of operation that must be used to generate harmonics necessary in the Octa-monic system.*

This unequal amplification results in the production of a wave of double the frequency of the incoming or carrier wave. In the plate circuit of the harmonic generator, the double frequency wave is taken off through a tuned circuit, while the fundamental or carrier wave is not used. The harmonic generator is then operated on the knee of the curve at the point employed in a "C" battery detector system. One might think from this that the harmonic generator is really a detector, but while detection does takes place it is only incidental.

In the harmonic-generator valve of the Octa-monic, the plate circuit is tuned to twice the frequency of the wave to which the grid circuit is tuned, thereby eliminating tendencies toward oscillation. This permits the design of an efficient tuned transformer for picking off the carrier wave, as more efficient coupling may be utilized.

To tune to twice the frequency of the incoming carrier wave, it is necessary to use either a smaller condenser or coil, or both.

The best commercial practice in the design of this double-frequency coil is to reduce the inductance of the coil to one-quarter of the value of inductance required for the broadcast frequencies. This eliminates the necessity for the use of special condensers, and also makes possible the ganging of the harmonic-generator tuning condenser and the detector-circuit tuning condenser on the same shaft; this gives an opportunity for single-control tuning.

(Continued on page 477)

MAKING A GOOD SET BETTER

Here is the Thordarson power-pack amplifier hooked up to a Crosley Bandbox, No. 601, a six-valve receiver of standard design. Low notes and high notes come through with astounding volume and clarity.

Try This New Power Unit on Your Old Receiver—

Thordarson Power-Pack Amplifier

With the unit described here you can eliminate your "B" batteries and put a 210 power valve wallop into any old or new receiver. And the construction and installation of the unit, as outlined below, can be done by any fan in a very short time.

By MORRIS M. SILVER

THERE are many times when the radio listener wishes that he could do away with the "B" batteries in his set, and at the same time use a power valve for improving his reception. The unit described here was developed for just this purpose in the Thordarson Radio Laboratories.

The Thordarson unit employs a 216-b rectifier valve, a voltage regulator valve and a 210 type power valve—the last to take the place of the ordinary power valve of the set. It may be built at home in a short time, and will supply 45 volts for the detector of an ordinary set, 90 volts for the amplifier and 135 volts for special use. It also supplies high voltage power for the 210 type valve.

The unit may be built up on a special metal chassis that is supplied by the manufacturer, upon which is mounted the power compact, including the power transformer and the two choke coils. A "B" block especially designed for the job is used for the filter circuits. Three sockets for the vacuum valves are also included, as well as an output transformer and suitable resistances for dividing up the voltages for the various potential outputs.

How to Construct the Unit

The metal chassis, K, is provided with a fiber base, L; both chassis and base are drilled and fitted with holes for the mounting screws and connecting wires used in building and wiring the unit. The first job to do will be to attach the three skeleton sockets, D1, D2 and D3, as shown in Figures 1 and 2.

Next mount the power compact, A, the condenser block, B, and the output transformer, C. The terminals for the sockets should be insulated from the metal base by means of the Bakelite spacing washers supplied with the kit.

Next mount the four resistors, E, F, G and H. These are mounted by means of machine screws of the proper lengths, inserted through the metal chassis and extending through the resistance unit, where a nut and lock nut threaded on will fasten them down tight. Four Bakelite spacing washers should be used for mounting these resistors and insulating them from the metal chassis.

Next mount the four binding posts, I1, I2, I3 and I4, and the constructional work will be complete.

Refer constantly to Figures 1 and 2 in building up the unit and in locating the instruments.

How to Wire the Unit

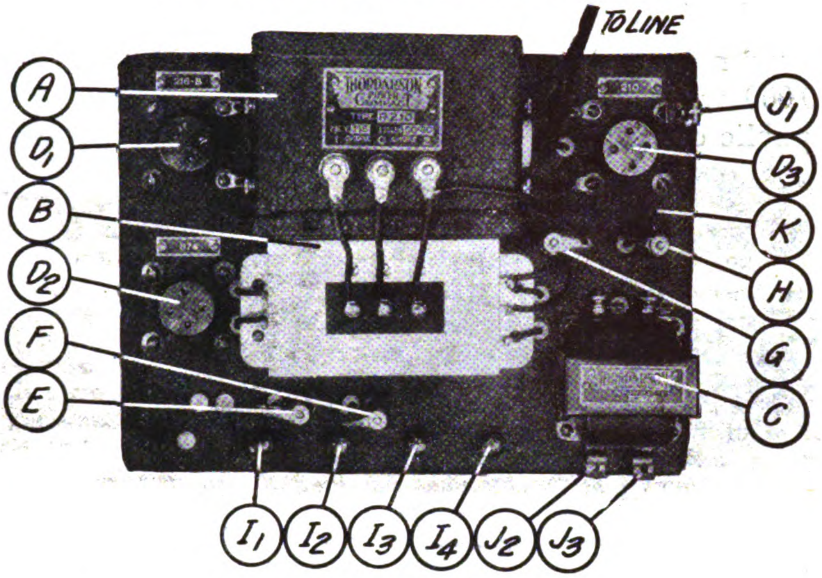
The picture wiring diagram, in Figure 2, shows the exact way to run the wires which connect the instruments, parts and binding posts. Follow this diagram exactly, using heavy rubber insulated hook-up wire. It will be noticed that the wiring in the diagram is shown in heavy red lines. The dotted red lines indicate that portion of the wiring that is to be run beneath the metal chassis. Solder all connections firmly, using soldering lugs wherever possible, fastened underneath the mounting screws or the terminal screws on the instruments.

Place two Fahnestock clips on the output terminals, J2 and J3, of the transformer, C, and place a Fahnestock clip on the grid terminal of the socket, D-3, shown in Figure 2.

(*Continued on page 469*)

POPULAR RADIO WORK SHEET

The Thordarson Power-Pack Amplifier



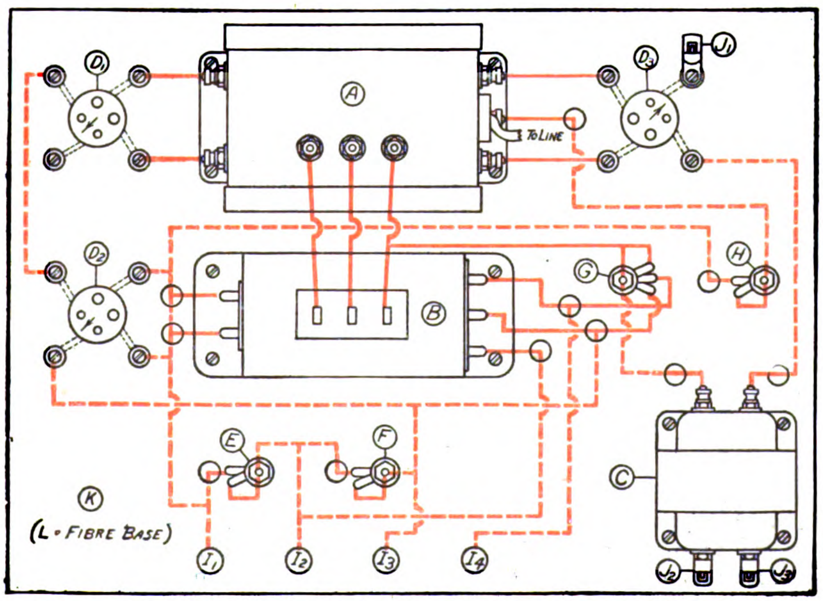
THE UNIT VIEWED FROM ABOVE

Figure 1: *In the simplified panel arrangement of the Thordarson power-pack amplifier, the rectifier valve and the voltage regulator valve are placed in the sockets to the left of the power transformer, and the 210 power valve in the socket at the right.*

List of Parts Necessary for Building This Unit

Cost of Parts—*Not over $54.00*

A—Thordarson power-pack, type R-210;
B—Tobe "B" block, type R-210;
C—Thordarson transformer, type R-76;
D1, D2 and D3—Benjamin Cle-Ra-Tone panel mounting sockets;
E and F—Ward Leonard Vitrohms, 10,000 ohms;
G—Ward Leonard Vitrohm, 8,000 ohms;
H—Ward Leonard Vitrohm, 1,000 ohms;
I1, I2, I3 and I4—Eby binding posts;
J1, J2 and J3—Fahnestock clips;
K—Metal base;
L—Fiber base that is furnished with the metal base, K.



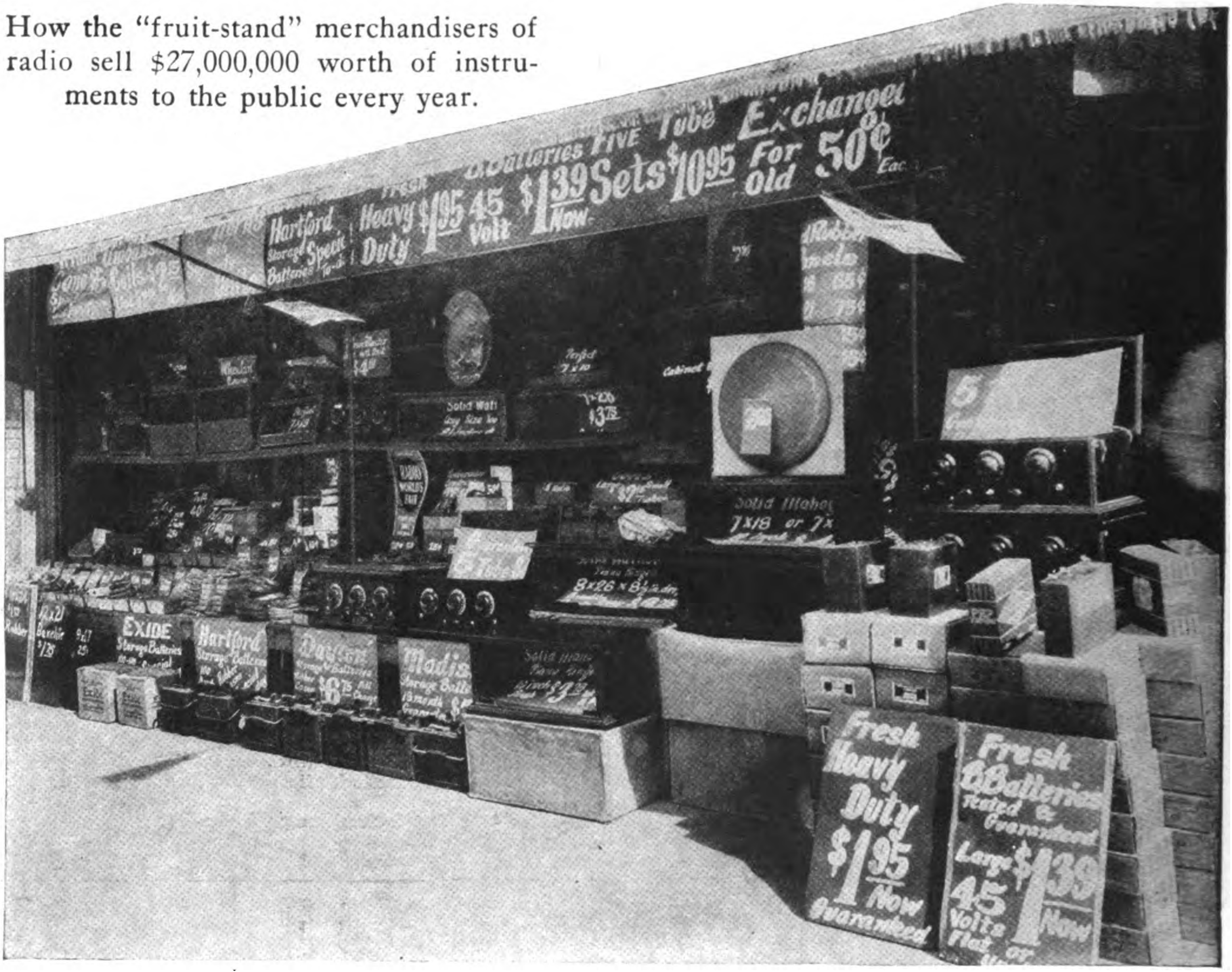
A SIMPLE WIRING JOB

Figure 2: *The solid* RED *lines indicate the wiring above the panel and the dotted* RED *lines the wiring under the panel. The instruments are outlined in* BLACK. *Dotted* BLACK *lines indicate the parts of instruments that extend under the panel.*

Every Day of the Year Is Big Bargain Day Down On

New York's Radio Row

How the "fruit-stand" merchandisers of radio sell $27,000,000 worth of instruments to the public every year.


Fresh B Batteries Five Tube Exchange
Hartford Storage Batteries
Heavy Duty $1.95
45 Volt $1.39 Now
Sets $10.95
For old 50¢ Each
Cabinet
Solid Mahog 7x18 or 7x
8x26x8
EXIDE Storage Batteries
Hartford Storage Batteries
Dayton Storage Batteries $6.75
Madison Storage Batteries
Fresh Heavy Duty $1.95 Now Guaranteed
Fresh B Batteries Tested & Guaranteed Large 45 Volts $1.39 Now

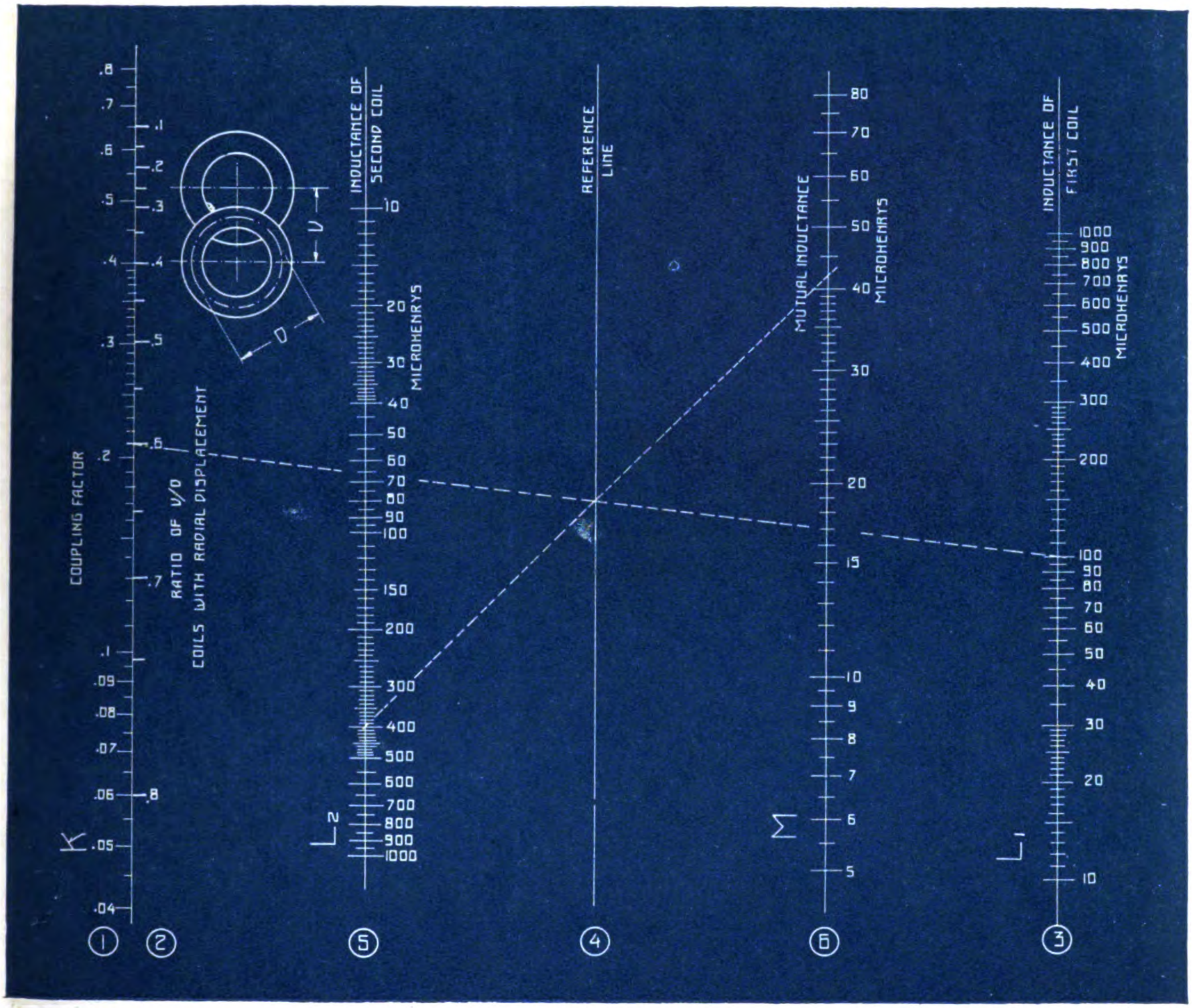
BACK in 1922, Cortlandt Street was just like any other downtown street in New York; but just as Fulton Street became far famed for its fish markets, so has Cortlandt Street become the "radio row" of the United States. Indeed, there is no other radio mart in the world even remotely like it. With Cortlandt Street as a center, one could draw a circle three blocks in diameter and include literally hundreds of radio retailers, large and small, with merchandising methods that extend all the way from "fruit-stand" tactics to large and beautifully appointed demonstration rooms to suit the most discriminating purchasers of radio receivers.

The history of New York's radio row is one of amazing growth. Back in 1922, when the industry was suffering from the effects of overproduction, a very wise and ingenious merchandiser, taking advantage of the distressed condition, set himself up in a two-by-four shop and did such a land-office business that at times the police reserves had to be called to control the crowds that stormed his cut-price emporium. The man who makes money quickly and easily in New York always finds a number of imitators, and the radio shops on Cortlandt Street multiplied fast and furious, until today over $27,000,000 worth of merchandise of all kinds and colors is sold to the New York and New Jersey radio public.

Radio Row has its buying sleuths scattered throughout the country, and these men always have their ears to the ground, anxiously waiting for the distant rumbling of a bankruptcy, so that they may rush in and offer the distressed manufacturer cash for his goods.

At various times and in various ways, Cortlandt Street has gone into the manufacturing business on an enormous scale. Not only has it done this, but it has subsidized manufacturers of "B" batteries, "B" eliminators, valves and loudspeakers. It buys in enormous quantities and it pays not one-sixteenth of a cent more than it has to pay for what it buys. Merchandise is passed along to the public at a very small margin of profit; for Cortlandt Street believes in the merchandising doctrine that if you sell enough you don't need much profit on the piece.

In the old days Radio Row used methods that were not in favor with the Better Business Bureaus, but while there are a few unscrupulous dealers left, much has been done to purify the atmosphere of this famous locality, and today even the man who is not an expert in radio values may buy with some feeling of security.



A MEASUREMENT CHART

For Use in Calculating the Mutual Inductance of Coils with Radial Displacement

By RAOUL J. HOFFMAN, A.M.E.

IN designing a new receiver, it is quite often found necessary for the engineer or experimenter to know the amount of mutual inductance between two coils. This may be calculated from the standard formula:

$$M = K\sqrt{L_1 \times L_2}$$

wherein

M = the mutual inductance;
L_1 = the inductance of one coil;
L_2 = the inductance of the other coil;
K = the coupling factor of the coils with a given displacement.

For coils having a radial displacement, illustrated by the small diagram in the chart, the value of mutual inductance of radial displacement has been calculated and prepared in the form of an allignment chart. Of course, in this case we must know the inductance of the coils that are to be coupled together.

To explain the use of the chart, let us consider the following example:

We want to find the mutual inductance of two coils that have an equal diameter of 3 inches and that are spaced 1.8 inches radially with an inductance of 100 and 400 microhenrys, respectively.

The spacing ratio is found by dividing the radial spacing, V, by the diameter, D, which in this case is 1.8 divided by 3, which equals .6. Looking at scale No. 2 on the chart, we find .6 in line with .21 on scale No. 1, which is the coupling factor, K. Connecting .6 on scale No. 2 with 100 on scale No. 3 and then connecting the intersecting point on reference line No. 4 with 400 on scale No. 5, we find this line intersecting scale No. 6 at 42, which is the value of the mutual inductance, M, in microhenrys.

Of course, any other values of coupling, within the values of inductance covered by the chart, may be determined in a similar manner.

This chart, and the others of this series, will be found invaluable in radio receiver and transmitter designs.

GET READY, FANS, HERE COMES A BIG NEW SET—

The Harkness Counterfonic

Unique ideas in high-frequency amplification are combined with the latest advances in double-impedance, low-frequency amplification in this most recent creation of Kenneth Harkness—the Counterfonic Six. Other features, as outlined in this advance article, include single-control tuning and simplicity in construction that will make the assembling of the new receiver a matter of only a few hours' work.

HARKNESS AND HIS LATEST CREATION

Here is Kenneth Harkness, the designer of the unique Counterfonic Six, giving his latest creation a workout in the POPULAR RADIO LABORATORY. *The tests show that the Counterfonic is a receiver of an astounding number of virtues—at a comparatively low cost.*

By CARL DORF

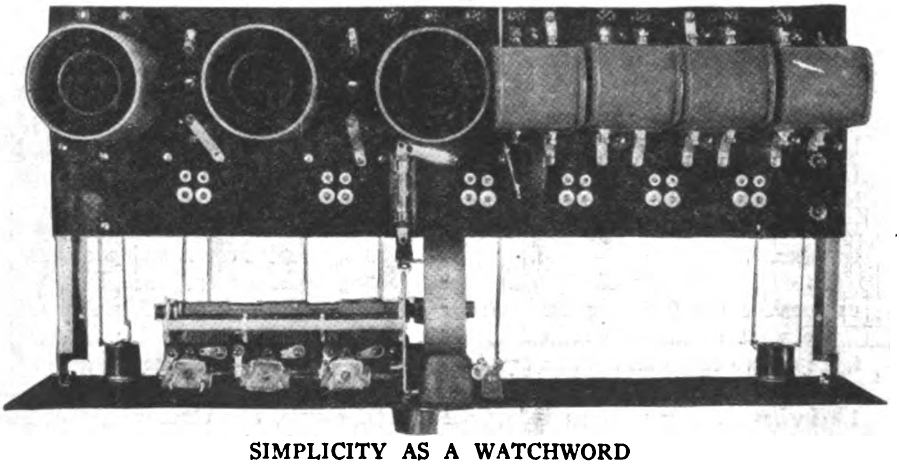
THE receiver designer of to-day has at his disposal a number of innovations that the past year in radio progress has made possible. The problem is to combine them in a circuit that makes the best use of all of them. It was with the idea of solving this problem that Kenneth Harkness set about in designing the Counterfonic receiver. The results have been satisfactory to the fullest degree. The completed Counterfonic is an easily constructed receiver that may be built for less than $60, and that combines the following outstanding features in a well-rounded and efficient ensemble:

1. Self-shielded coils;
2. Jiffy construction;
3. A simple selectivity control;
4. Easy neutralization;
5. The famous Hiler double-impedance amplification scheme;
6. An output filter of improved design.

The new high-frequency coils, designed by Harkness especially for the new set, consist of straight solenoid coils, shielded individually by heavy copper cylinders. The copper cylinders are open at each end so that the inductance of the coils is not materially impaired, although satisfactory shielding results are obtained. Figure 4 shows the coils in detail.

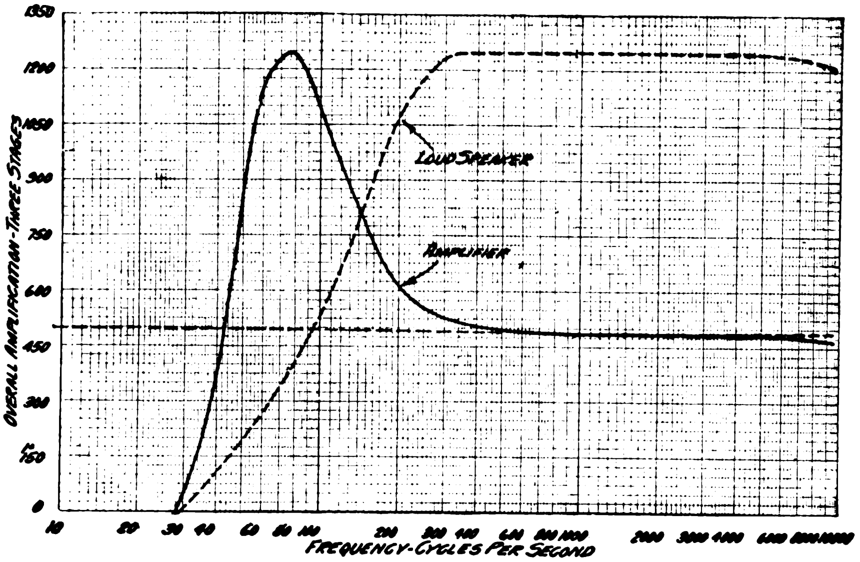
The antenna coil consists of three windings, one in the antenna circuit, one in the grid circuit, and the third winding for neutralization. The second coil is similar, consisting of the same three windings. The first winding is to be connected in the plate circuit of the first high-frequency valve, and the second winding in the grid circuit of the second high-frequency valve; the third winding is for the purpose of neutralization. The third coil consists of but two windings, one in the plate circuit of the second high-frequency coil and the second in the grid circuit of the detector valve.

The arrangement of the parts has been simplified by using a sub-panel assembly incorporating ready set-up sock-



SIMPLICITY AS A WATCHWORD

FIGURE 1: *Notice at the left the three high-frequency coils, individually shielded with copper tubing. The four units at the right comprise the new three-stage, double-impedance, low-frequency amplifier with an output filter. The triple-gang condenser that permits single-control tuning is at the lower left. The wiring has been so simply laid out that the set almost wires itself.*



HOW THE LOW TONES ARE REALIZED

Figure 2: *The curve shown in the solid black line indicates the resonant peak of the tuned-low-frequency amplifier of the Counterfonic Six, between 60 and 100 cycles—the lower notes of reproduction. The curve in dotted black is a composite curve of reproduction for a number of loudspeakers, showing how their amplitude falls off at the lower frequencies, thus eliminating the low notes. The Harkness amplifier is tuned to compensate for these inherent defects in loudspeakers, so that the final output of the loudspeaker has an amplitude that is the same for both high and low notes.*

ets with strip connections, so that wiring and assembly operations are cut to a minimum. A triple-gang condenser is furnished with a drum dial. Each tuned circuit, comprising the secondary windings of the three high-frequency coils and one section of the triple-gang tuning condenser, is adjusted to exact resonance by means of a midget variable condenser. This feature guarantees highest efficiency in tuning with single control.

An antenna switch arrangement for short-circuiting a fixed condenser in the antenna circuit gives a double selectivity range for the receiver, and also enables the set to be operated on either a long or a short antenna at highest efficiency.

By using a third winding in the two high-frequency circuits and two small semi-variable condensers, each high-frequency circuit may be individually neutralized in a few seconds with a common screwdriver. The set can be easily adjusted so that oscillation is entirely eliminated once and for all.

Now we come down to the part of the receiver that gives such marvelous tone quality.

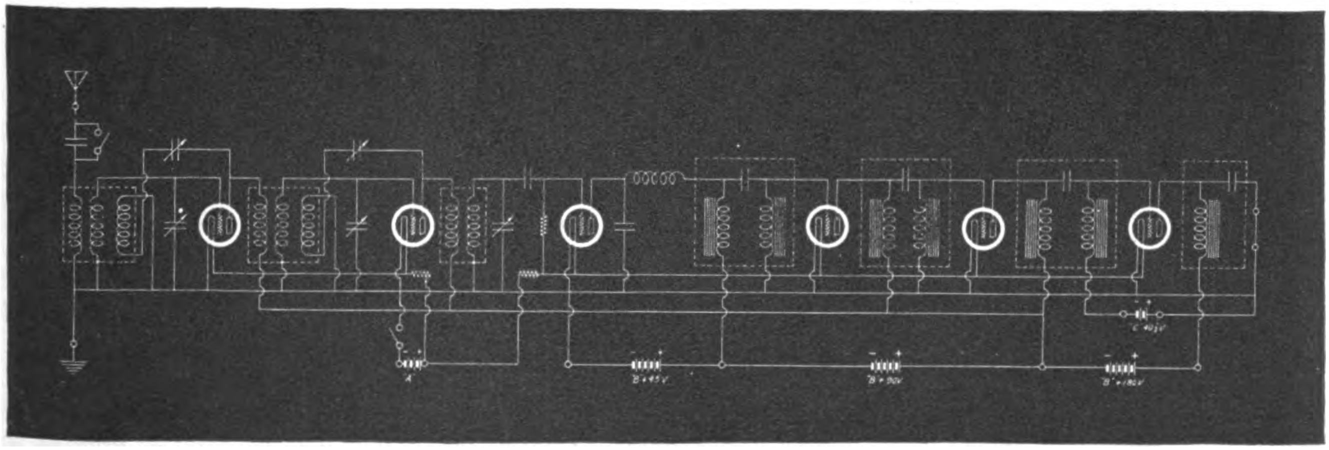
The receiver incorporates three stages of double-impedance amplification following the detector, which is equipped with a high-frequency filter to keep high-frequency currents out of the amplifier. The low-frequency, double-impedance amplifier is tuned to highest efficiency at audible frequencies that lie between thirty and two hundred cycles. Figure 2 shows the amplification curve of the amplifier in comparison with a composite outline curve of a number of modern loudspeakers. It will be seen that the effect of the high amplification peak in the amplifier makes up for the lack of reproduction of low notes in the loudspeakers, thus insuring a wealth of the beautiful low tones that are missing from old-time receivers.

The output of the last power valve in the new receiver is fed into the output filter, which again eliminates a large amount of distortion and protects the loudspeaker windings from the high-voltage direct current that would ordinarily flow through its windings.

An idea of the simplicity of the new receiver, with its well-designed layout, may be gained from a study of Figure 1. If a line were to be drawn through the center of the receiver, the portion at the left would contain the complete high-frequency amplifier, including the detector, while at the right is the complete low-frequency amplifier; thus the receiver is divided into its two separate functions of high-frequency and low-frequency amplification. At the center is the illuminated drum dial with its control knob that does all the tuning in a single operation. Underneath the control knob is the volume control knob, which is the only other control on the receiver except an "on" and "off" switch.

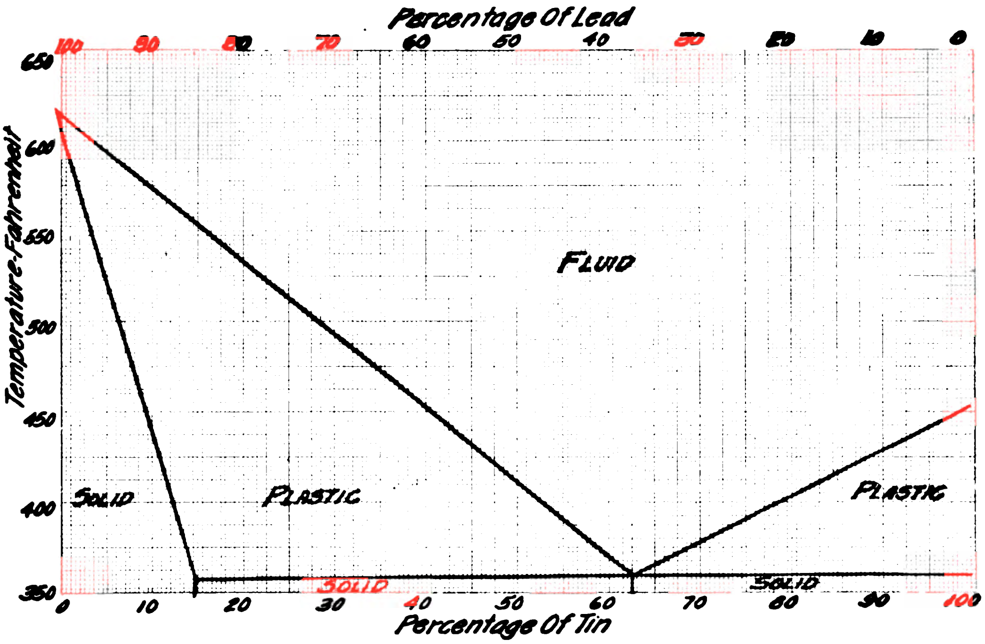
The new set has been especially designed for the prospective broadcast listener who wants a set that will be medium priced, that he can easily build at home on the kitchen table, and that

(*Continued on page 460*)



THE SCHEMATIC DIAGRAM OF THE COUNTERFONIC CIRCUIT

Figure 3: *At the left are the two high-frequency stages and the detector stage, with their novel schemes for shielding and neutralization. The tuned double-impedance, low-frequency amplifier is at the right, with the output filter.*



HOW DIFFERENT SOLDERS REACT TO HEAT

This chart shows graphically the physical states through which tin-lead solders of various percentages pass on the application of heat. The alloy of 63 per cent tin and 37 per cent lead passes from the solid to the liquid state immediately, while alloys of other percentages pass through a plastic stage of a duration depending on the proportions of tin and lead present.

The New Science of Soldering

By P. C. RIPLEY*

SOLDER, as we know it to-day, is formed by alloying the metals tin and lead. Tin, the more expensive metal of the alloy, is of a distinctly white color, crystalline in structure, and almost entirely devoid of tenacity. In its pure state it has a melting point of 450 degrees Fahrenheit.

Lead, the other component metal of solder, is less expensive. It is bluish white in color, soft, plastic, and almost entirely non-elastic. In a pure state, it has a melting point of 621 degrees Fahrenheit.

By alloying the two metals tin and lead, we secure an alloy with a melting point that is considerably lower than that of either of the component metals. By adding the metals bismuth and cadmium to the tin and lead, we can still further lower the melting point, but by so doing we destroy some of the valuable attributes that tin-lead alloys display. For all practical purposes in the construction of radio receiving and sending apparatus, tin-lead alloys serve admirably, and the average home constructor of receivers need give little concern to alloys containing bismuth or cadmium. Their cost is excessive and the strength of such alloys is measurably lower than those of tin and lead.

Now, by varying the proportions of tin and lead in the making of the alloy, we secure certain well-defined characteristics in their physical behavior in the molten and solidified states. This largely determines the selection of an alloy for specific use. At one point in the possible ninety-eight alloy percentages we discover a strangely different behavior from any other alloy of the group. This occurs when we take 63 per cent tin and 37 per cent lead and melt them together. In this percentage we have what is termed the eutectic mixture of the tin and lead group. It gives us the lowest melting point that we can secure in the alloys of tin and lead without the intermixing of bismuth or cadmium. One property that this alloy displays that none of the other alloys manifest is that in passing from molten fluidity to solid, or vice versa, the transition is instantaneous; there is no plastic or mushy intermediate state in the change. Any other alloy percentage will display this intermediate plasticity, although alloys closest to the eutectic will possess the shortest periods of plastic state. Regardless of how rapidly or how slowly we cool the eutectic alloy, the change will be just as well defined and sudden. The ordinary commercial alloys more commonly employed for solder are combined in such proportions as 50 per cent tin and 50 per cent lead, or 45 per cent tin and 55 per cent lead, or 40 per cent tin and 60 per cent lead, or 35 per cent tin and 65 per cent lead.

To illustrate the changes in alloys under the action of heat and the resultant stages, refer to the chart at the beginning of this article, which graphically illustrates the approximate temperatures such stages and changes occupy in the various alloys. From this chart it is possible to calculate roughly the softening point and the point of fluidity of any alloy of the tin and lead group, and also the amount of temperature increase above the melting point of the eutectic necessary to induce complete fluidity.

Unless you are qualified to judge solder, it will be a wise plan in your selection of solder for use on your radio receiver to purchase a kind that carries the endorsement of the manufacturer as being suitable for radio use. The ordinary commercial solders are frequently made from reclaimed or scrap metals and are likely to contain

(*Continued on page 473*)

---

*Mr. Ripley, the author of this illuminating article on solder, is at present Chief Engineer of the Chicago Solder Co.

The appearance of the Hi-Q receiver, when installed in its console cabinet, makes it a suitable and tasteful addition to any home. The cabinet in the picture at the left is done in walnut.

HOW TO GET PERFECT RESULTS WITH

The Hammarlund Hi-Q "Six"

With the help of the suggestions given in this article, the operation of the Hammarlund Hi-Q "Six" can be simplified to a remarkable extent, and the receiver can be made to operate far more efficiently and with better results in quality reproduction—at less expense.

By RAYMOND FRANCIS YATES

IN building a radio receiver an experienced set builder usually learns a great deal about the theory and operation of the circuits employed, by study and careful consideration of the function of each instrument as he puts the set together. However, for set builders in general, whether they be amateurs, broadcast listeners, professional set builders or just plain novices building their first set, an article of hints for operating the Hi-Q Six receiver may help in solving some point of operation.

The Hi-Q receiver, as has been explained in previous articles on theory and construction, is a well designed, well executed piece of radio engineering, and if it has been built according to instructions, and wired correctly, results of a very high order should be obtained.

Let us consider that the set has been constructed and wired, checked and found correct, and that it has been installed in its cabinet and the batteries connected, as shown in Figure 1. The switch on the receiver should be turned to the "on" position. The volume control should also be turned full "on" and the two tuning controls revolved simultaneously, keeping both at approximately the same settings. If signals are not received immediately, connect a pair of headphones across the terminals marked "P" and "B" of the first low-frequency transformer. If signals are heard in the headphones but not in the loudspeaker it is certain that the trouble is in the low-frequency circuit, and it should be checked over again. If signals are not heard in the headphones the trouble is in the detector or high-frequency circuits, and these should be traced until the trouble is found and corrected.

On most wavelengths the two tuning controls should be set approximately alike except for a slight variation that may occur in the first dial with varying lengths of antenna.

Never turn the volume control higher

than is absolutely necessary to get the proper strength of signal.

If, upon turning the set "on," a continuous howl goes up, a defective or microphonic valve may be the cause. If this trouble occurs, tap each valve with the finger nail and find out which one is causing it.

Such valves sometimes give trouble as detectors or low-frequency amplifiers, but are perfectly efficient in the high-frequency stages. If any one valve cannot be made to work properly by placing it in a different socket, a new valve should be substituted.

Hook-up Combinations for the Hi-Q

The type of batteries and the size of amperites required in this set depend upon the kind of valves employed. For maximum efficiency it is recommended that with battery operation the new 112-a or 171-a type valves be used in the last stage; with dry-cell hook-ups a 120 type valve would be best. The new 112-a and the 171-a type valves are similar to the old 112 and 171 type valves except that they employ oxide filaments that consume only .25 ampere instead of .5 ampere.

Four hook-up combinations are listed below, and Combination No. 1 is recommended for ordinary use:

COMBINATION NO. 1

Five 201-a or SX-401-a type valves in sockets Nos. 1, 2, 3, 4 and 5.
One 112-a or SX-412 type valve in socket No. 6.
One 6-volt storage "A" battery or Balkite "A" Eliminator.
Three 45-volt "B" batteries.
Two 4½-volt "C" batteries.

COMBINATION NO. 2

Five 199 or SX-499 type valves in sockets Nos. 1, 2, 3, 4 and 5.
One 120 or SX-420 type valve in socket No. 6.
One 4½-volt dry-cell "A" battery.
Three 45-volt "B" batteries.
One 22½-volt "C" battery.
One 4½-volt "C" battery.

COMBINATION NO. 3

Six 199 or SX-499 type valves throughout.
One 4½-volt dry-cell "A" battery.
Two 45-volt "B" batteries.
One 4½-volt "C" battery.

COMBINATION NO. 4

Six 201-a or SX-401-a type valves throughout.
One 6-volt storage "A" battery or Balkite "A" Eliminator.
Two or three 45-volt "B" batteries.
One or two 4½-volt "C" batteries.*

If valve combination No. 2 or No. 4 is used, three Carter No. RU-20 (20 ohms) resistance units should be substituted for the resistances furnished in the foundation unit. A Carter No. IR-20 (20 ohm) or a Carter No. IR-25 (25 ohms) Imp rheostat should be substituted for the Carter No. IR-6 (6 ohms) rheostat specified in the standard parts list for building the set.

To secure the full advantages of the 171-a or 171 valves, four 45-volt "B" batteries should be used and a 40-volt "C" battery should be connected to the brown wire of the cable. With these voltages the plate current drawn under normal conditions is 18 or 20 milliamperes, which is too much to pass safely through the windings of the average loudspeaker.

This difficulty can be easily overcome by connecting a Samson No. 30 choke coil directly across the loudspeaker binding posts. Mounting holes for this choke are provided on the steel chassis near the loudspeaker binding posts. As the resistance of the average loudspeaker winding is considerably higher than the direct-current resistance of this choke coil, most of the 18 or 20 milliamperes of plate current will pass through the choke coil. This will prevent the burning out of the loudspeaker winding by the heavy direct current of the power valve.

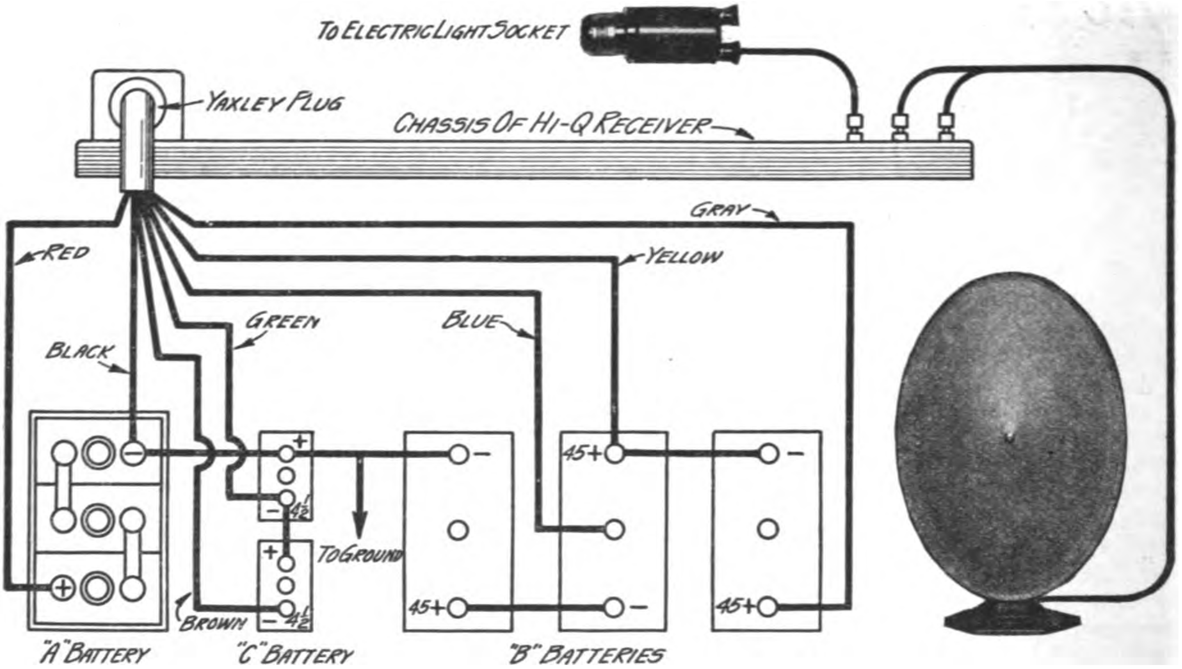
Accessories Recommended for Use With the Hi-Q "Six"

For those desiring to do away with the regular "A" batteries, the Balkite "A" power-pack has been found exceptionally well suited for use with this receiver. The unit consists of a rectifier and an electrolitic filter condenser combined in a single pack. It is complete and requires no other accessories, and furnishes noiseless filament current from the lighting lines. It requires no

(*Continued on page 453*)

---

*Note: If only two 45-volt "B" batteries are used, only one 4½-volt "C" battery is necessary, and both the green and brown cable leads should be connected to 4½ volts negative (—). The yellow and gray cable leads should both be connected to 90 positive (+).



AN IMPROVED HOOK-UP FOR THE HI-Q "SIX"

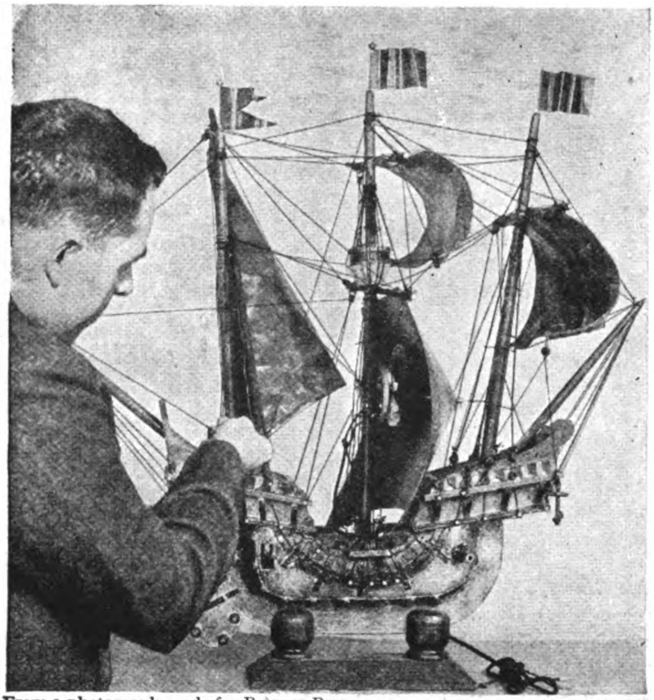
FIGURE 1: *This diagram shows the complete hook-up for operating the Hi-Q most efficiently with batteries, and it includes the socket antenna, shown at the top, that does away with the problem of erecting an antenna.*

What's New *in* RADIO

Conducted by

THE TECHNICAL STAFF

Inventors, experimenters, manufacturers and readers generally are invited to keep the Technical Staff of POPULAR RADIO informed of all new apparatus that is of their own creation or that comes to their attention; if the apparatus passes the tests of the POPULAR RADIO LABORATORY, it will be duly recorded in this Department for the information and benefit of all.



From a photograph made for POPULAR RADIO

A SHIP MODEL THAT TALKS

This decorative ship model of Columbus' craft, LA PINTA, *constitutes one of the most unique loudspeakers that has ever been shown in these columns. The ship itself is a perfect gem from a decorative standpoint, and the mainsail acts as a cone loudspeaker, giving excellent quality of reproduction and volume enough for any home use. It is manufactured by the Miniature Ship Models Company.*

A "B" Power-Pack That Requires No Adjustment

Name of instrument: Socket Power No. 671.

Description: This unit contains a rectifier, a filter and a voltage divider, combined in a single enameled case to provide smooth, uninterrupted supply of plate voltage for the operation of any receiver employing up to seven valves, including a UX-171 type power valve in the last low-frequency stage. This power-pack is designed to provide long service. It employs a gaseous rectifier valve of the Raytheon BH type, and gives a maximum output voltage of 180 volts for the power valve, with intermediate and detector voltages of approximately 90 volts and 45 volts, respectively. A "C" bias suitable for use with a UX-171 type valve is also provided. All connections between the power-pack and the receiver are made by means of a cable which is included with the power-pack. The cord and plug for connection to the electric light socket is equipped with a pendent switch for tuning the unit "off" and "on."

Usage: To supply all plate voltages for the operation of receivers with up to seven valves, including a power valve. Operates from the 110-volt, 60-cycle lighting lines.

Outstanding features: Sturdy. Ample factor of safety in all parts. Operates on input voltages from 105 to 130. Neat appearance.

Maker: A. H. Grebe Co.

A Battery Charger With Two Charging Rates

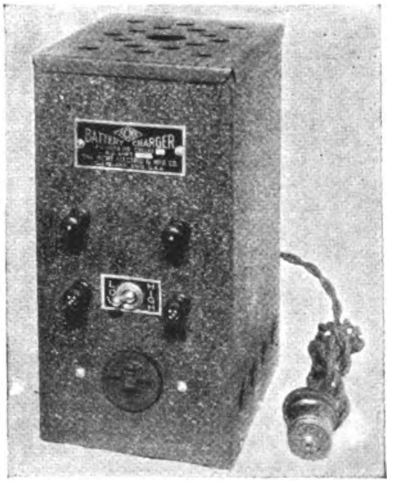
Name of instrument: Combined battery charger and automatic control switch, model ATCSR.

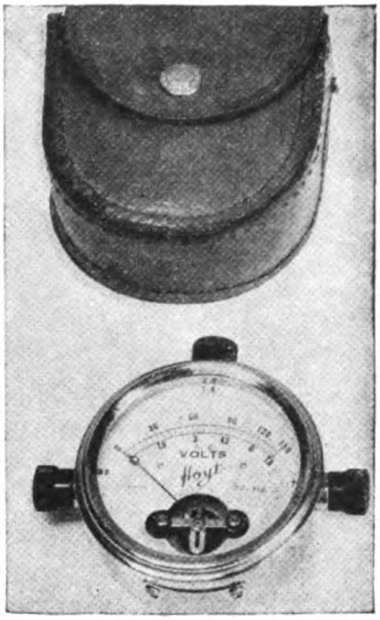
Description: This battery charger makes use of a 2½-ampere Tungar rectifier bulb and provides two charging rates of 1½ and ½ ampere. A toggle switch is provided on the case of the instrument to permit changing from one rate to the other without the necessity for changing the connecting wires. The case also includes a self-contained relay switch which automatically turns the charger "off" when the receiver is turned "on," and vice versa. In addition to this, a receptacle on the front of the charger case provides a connection for the "B" power-pack, if one is used. This is to provide automatic control of the "B" power-pack; that is, to turn it "on" when the receiver switch is turned "on," etc. The case is of metal with a crystalline finish and is perforated to provide adequate ventilation to dissipate the heat from the rectifier valve. The trickle charge rate of ½ ampere should be adequate to keep the storage battery charged, except in cases where the service is unusually heavy, in which event the high charging rate may be resorted to occasionally to bring the battery up to full charge.

Usage: For the charging of a storage battery and automatic control of the charger, as well as the "B" power-pack.

Outstanding features: Saves space in cabinet because of the combining of the charging and switching units into one. Provides a low charging rate for normal use and a high rate for occasional use where the battery is used at heavy loads.

Maker: Acme Electric & Mfg. Co.





A Handy Instrument for Checking Batteries

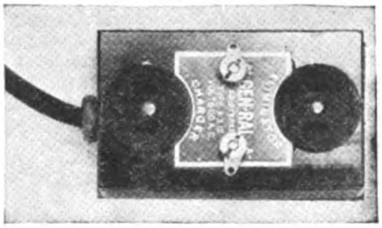
Name of instrument: Two-range voltmeter.

Description: This instrument is inclosed in a nickel-plated case that protects the mechanism. The face of the instrument is equipped with a highly visible double scale. The upper scale provides voltage readings up to 150 while the lower scale has a maximum of 7.5 volts. The meter is of the moving-coil type and is small enough in size to fit easily into the pocket. It is equipped with a leather carrying case.

Usage: To check the "A" and "B" battery voltages in a radio receiver.

Outstanding features: Compact in size. Calibrated with the necessary degree of accuracy. Equipped with leather carrying case. Contains a zero adjustment feature.

Maker: Hoyt Electrical Instrument Works.



Automatic Control for "A" and "B" Power

Name of instrument: Gen-Ral automatic relay switch, type AX-12.

Description: This switch is operated by a magnet energized by the "A" battery current flowing to the receiver. The contacts of the switch are of silver. When the panel switch on the receiver is turned "on," the current to the filaments flows through the magnet winding of the automatic switch, and this causes contacts to be made inside of the switch; this closes the line circuit to the "B" power-pack. When the receiver switch is turned "off," the power-pack circuit is opened and the circuit to the trickle charger is closed, thus putting the battery on charge. The entire unit is enclosed in a bakelite case, on the top of which are receptacles for the plugs from the charger and the power-pack; there are also two binding posts for connection to the "A" battery circuit. The instrument is equipped with an extension cord and plug for connection to the 110-volt, alternating-current lighting lines.

Usage: To automatically control the AC supply to the trickle charger or power-pack, or both, by means of the filament switch on the receiver.

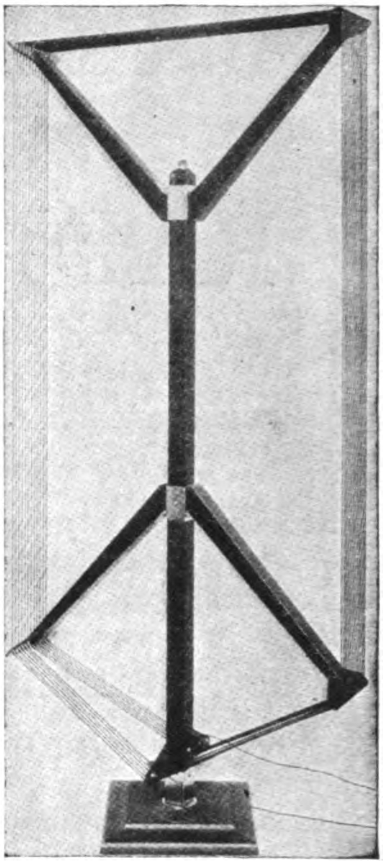
Outstanding features: Small in size. Positive in operation. Switch contains silver contact points. Easily installed.

Maker: General Mfg. Co.

The Wire Cannot Sag on This Folding Loop

Name of instrument: Quali-Tone loop antenna.

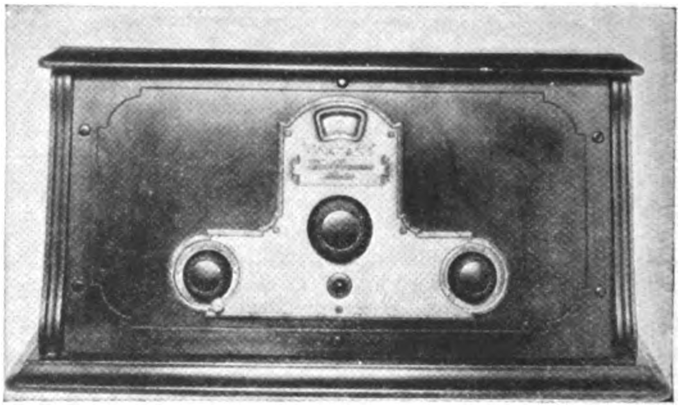
Description: This loop, when open, measures 16 inches across by 34 inches in height. When closed it is 14 inches by 6½ inches by 3 inches. The frame is of walnut finish, with nickel-plated metal trimmings. A thumbscrew adjustment is provided by means of which the loop winding can always be kept absolutely taut—a feature which adds much to the appearance, as well as to the permanently accurate values of inductance and distributed capacity. The loop is set in a swivel base and is provided with three long, flexible leads for the connections to the receiver. These leads represent the two outer terminals of the loop winding and a center tap. Each is equipped with a phone tip. The loop is designed for use with a .0005 mfd. variable tuning condenser.



Usage: As an antenna for use with superheterodyne and other receivers that are designed for loop operation.

Outstanding features: Winding always taut. Fine appearance. Provided with flexible connecting leads and a center tap.

Maker: Duro Metal Products Co.



A Small Receiver With Large Results

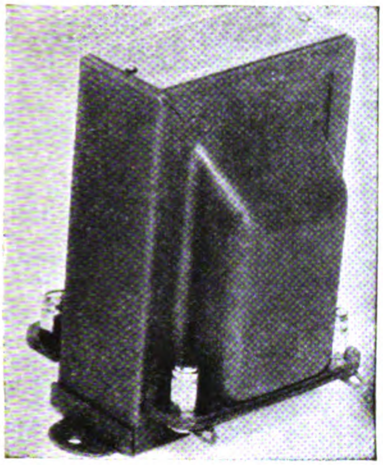
Name of instrument: Freed-Eisemann NR-9 receiver.

Usage: For radio broadcast reception.

Outstanding features: Sensitive to weak and distant signals. Fine tone quality. Plenty of volume. Compact.

Description: There has been a decided trend recently toward radio receivers of large dimensions, and many of the uninitiated public seem to have gained the impression that the value and ability of a receiver vary in proportion to size. It is true that many of the most expensive receivers are large in size, but even in these cases the great size is not necessary to the efficiency of the receiver. Instead the huge console cabinets are provided to house the reproducer or power-packs and also to make the outfit more impressive in appearance. An internal inspection of even these expensive receivers will disclose that the space occupied by the receiver itself is comparatively small. In purchasing a large receiver, a good part of the purchase price goes for the cabinet. If one desires a large, impressive looking piece of furniture, this is

(Continued on page 468)



A Transformer That Gives Lifelike Reproduction

Name of instrument: Superaudioformer low-frequency transformer, type No. 27-A.

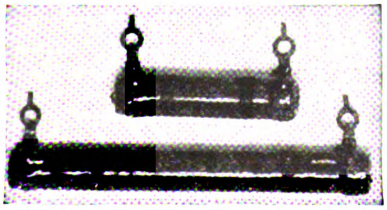
Description: This transformer is of generous proportions and is designed to provide practically even amplification throughout the range of audible frequencies. Its characteristic curve shows an equal voltage amplification at frequencies from 200 to 1,500. Below 200 cycles there is a gradual falling off, until at 60 cycles the amplification is about 75 per cent of that obtained above 200 cycles. At 1,500 cycles the curve begins to rise gradually to a maximum at 4,500 cycles. This maximum value is approximately 25 per cent. higher than the amplification value from 200 to 1,500 cycles.

The transformer is inclosed in a metal case that is finished in satin bronze. It is equipped with terminal mounting strips of composition material and with mounting flanges at the bottom of the case for use in attaching the transformer to the baseboard or sub-panel of a receiver. The terminals are clearly marked on the top of the transformer case, so that there can be no error in connecting the instrument.

Usage: To provide coupling between the valves of a low-frequency amplifier and for use in both first and second stages.

Outstanding features: High amplification. Turn ratio 3 to 1. Good voltage amplification characteristic. Logical arrangement of terminals. Neat appearance.

Maker: Pacent Electric Co., Inc.



Wire Wound Resistors Rated at 20 and 40 Watts

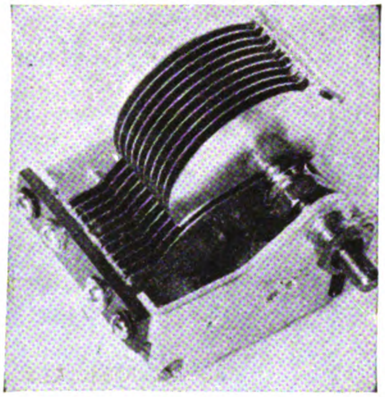
Name of instrument: Aerovox Pyrohm resistors, type Nos. 994 and 992.

Description: These resistance units consist of suitable resistance wire which is wound on tubes of refractory material and is then coated with a porcelain enamel to protect the wire from oxidization, moisture and breakage. The materials used are carefully selected so as to have the same coefficient of expansion and thus these resistances may be worked under heavy loads without injury to the wire. Contact is made by means of broad metal bands which are clamped onto the wire before the enamel is baked on. These connections terminate in soldering lugs. The larger resistance shown here is a 25,000-ohm unit with a current-carrying capacity rating of 40 watts. Its size is 3¾ by ½ inch. The smaller unit is rated at 20 watts and has a resistance of 25,000 ohms. Its size is 2 by ½ inch. Either of these types of resistors may be obtained in resistance values from 500 ohms to 50,000 ohms.

Usage: Voltage-reducing or voltage-dividing resistances in the output circuits of "B" power-packs. Or for any service that requires the use of a high resistance that is capable of dissipating 20 watts or more.

Outstanding features: Small size. Clearly labeled as to resistance values. Will withstand heavy duty without any material change in resistance values.

Maker: Aerovox Wireless Corp.



A Tuning Condenser for Limited Space

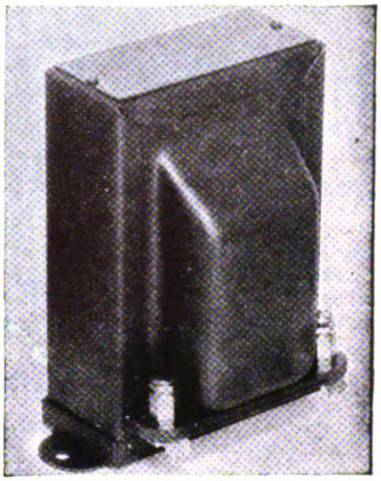
Name of instrument: Universal compact variable tuning condenser, type UX.

Description: The rotor and stator plates of this condenser are of unusual shape and are so designed as to take up a minimum space. The rotor plates, which in most condensers are much longer than they are wide, are almost round. The arc through which they swing is therefore small and the total space required for mounting this condenser is 3⅛ by 3 by 2⅜ inches. The plates are of brass, except the end plates, which are of aluminum. The stator is insulated from the rotor by means of two narrow strips of high-grade insulating material. All plates are securely held in place and accurately spaced. The tuning curve of this condenser is a modified straight-frequency line. The shaft is removable and can readily be replaced with a long shaft for the purpose of operating several of these condensers on a single shaft for single-control tuning of multi-stage receivers. Also, there is no front or back to this condenser. It is identical on both ends and may be mounted with either end next to the panel to provide clockwise or anti-clockwise movement, as desired.

Usage: For any purpose where a variable capacity is required, particularly for tuning the high-frequency stages of a radio receiver.

Outstanding features: Compact. Electrically efficient. Removable shaft. Good tuning characteristic.

Maker: United Scientific Lab., Inc.



A Choke for Use in Power Amplifiers or Power-Packs

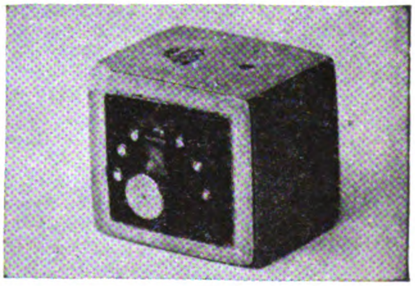
Name of instrument: Audiochoke (low-frequency choke).

Description: This choke consists of a large iron core and coil winding of high inductance and comparatively low direct-current resistance. It is inclosed in a metal case of exactly the same size, shape and finish as the Superaudioformers, types No. 27-A and 27-B. This choke is capable of handling up to 60 milliamperes and at this current has an inductance of 32 henrys. At 50 milliamperes DC the inductance is 36 henrys and increases to 50 henrys at no DC load. The DC resistance of the choke is 575 ohms, and it will withstand up to 500 volts continuously.

Usage: In power amplifiers or in the filter systems of "B" power-packs, with voltages up to 500, and currents up to 60 milliamperes.

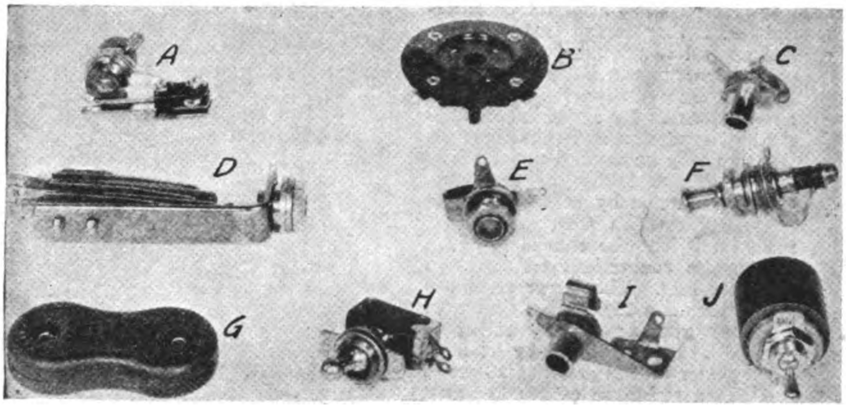
Outstanding features: High inductance and high current-carrying capacity. Good design and construction.

Maker: Pacent Electric Co., Inc.



ANOTHER "SMALLEST" SET

This addition to the long succession of Lilliputian radio receiver models measures less than one inch square, although it uses 35 feet of wire. Ordinary pins do the work of tuning points. It is the work of Harold C. Palm, of Cherokee, Ia.



Small Parts for the Set Builder

Name of instruments: Radio connection and switching devices.

Description: (A) A panel mounting type of single-pole, single-throw switch. The frame is of metal. The contact members are of spring metal and are well insulated from each other by composition material. The switch is intended for single-hole, panel mounting and is operated by a rotary knob.

(B) A valve socket that is intended for mounting on the under side of a receiver sub-panel. It consists of a molded composition body on which are riveted the contact springs. These springs extend beyond the body to serve as soldering terminals, thus providing one-piece terminals. Mounting holes are provided in the body to permit the use of either one or two mounting screws or rivets.

(C) A panel mounting jack that is mounted by means of a single machine screw and nut. It is extremely simple in construction and compact in size. The insulation is thorough, and terminals are provided in the form of soldering lugs which are extensions of the contact elements.

(D) A standard panel-mounting jack. This consists of a strong metal frame with the usual screw bushing for attachment to the panel by means of a single hole. The contact springs are solidly anchored and thoroughly insulated. These springs are heavy and provide strong contacts. The jack illustrated is a double-circuit, filament control type, for use in the first low-frequency stage of a receiver.

(E) Another small jack which is mounted on the panel in the same manner as the large standard jacks. When mounted in position it extends back only a half inch from the panel and is therefore convenient for use where space is limited. Good substantial contact is provided. It is connected into the circuit by means of one-piece lug terminals.

(F) This push-pull battery switch consists of the jack (E) with a brass plunger. The plunger is equipped with an insulated collar so arranged that when the plunger is pushed in the collar comes in contact with one of the terminals of the jack and breaks the circuit. When the plunger is pulled out it short-circuits the jack terminals and permits the current to flow through the circuit.

(G) This extension cord connector consists of a composition block inside of which are four spring receptacles for phone tips. These receptacles are connected together in pairs so that an extension cord may be connected to the ends of the loudspeaker cord by inserting the reproducer terminals in the holes in one end of the connector and the extension cord terminals in the corresponding holes in the other end of the connector.

(H) An extremely compact battery or power switch of the "toggle" type. It is mounted on the panel of a receiver by means of a single hole and is equipped with a marker plate which fastens under the nut on the panel front and bears the designations "off" and "on". The current is turned "off" and "on" by pushing up or down on the small lever which projects in front of the panel. The overall size of the portion behind the panel is approximately ¾ inch by ½ inch. The parts that appear on the front of the panel, including the bushing, nut, lever, and marker plate, are all nicely finished in gold. It may be used in power lines to carry up to 3 amperes at 125 volts and is approved by the Underwriters Laboratory for this use.

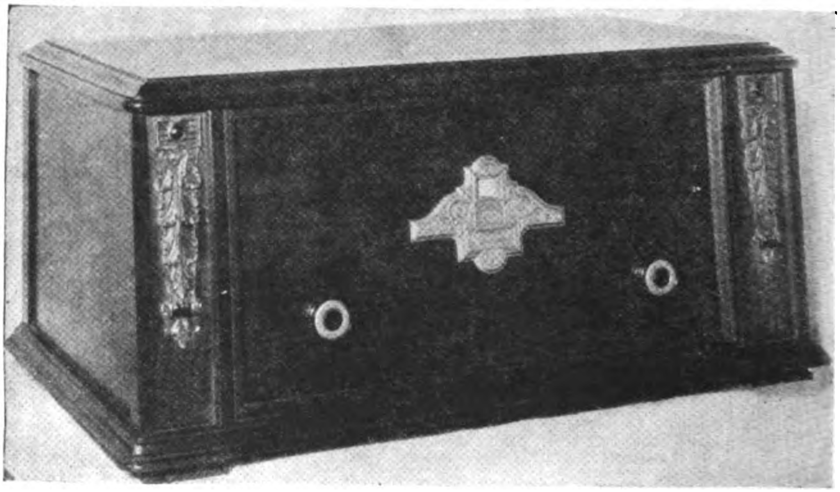
(I) This single circuit jack is designed for baseboard mounting. The jack itself is identical with that described in C above but has an extension frame with two screw holes for use where the jack is to be attached to the baseboard instead of to the panel of a receiver. Especially useful in making experimental layouts and in other experimental work where no panel is used.

(J) Another toggle switch for controlling the filament supply. This switch consists of a composition barrel which incloses the contact elements. Terminals are provided in the form of screws at the back of the switch. It is equipped for single hole, panel mounting and has an "off-on" marker plate. Metal parts are finished in nickel.

Usage: For various switching and connections purposes in a radio receiver.

Outstanding features: All rugged in construction. Well finished. Neat in appearance. Compact in size. Extremely moderate in price.

Maker: Saturn Mfg. & Sales Co., Inc.



A Receiver With Real Single Control

Name of instrument: Pfanstiehl Overtone Receiver, Model 30.

Usage: For radio broadcast reception.

Outstanding features: Absolutely single-control tuning. Highly sensitive. Good selectivity. Attractive appearance.

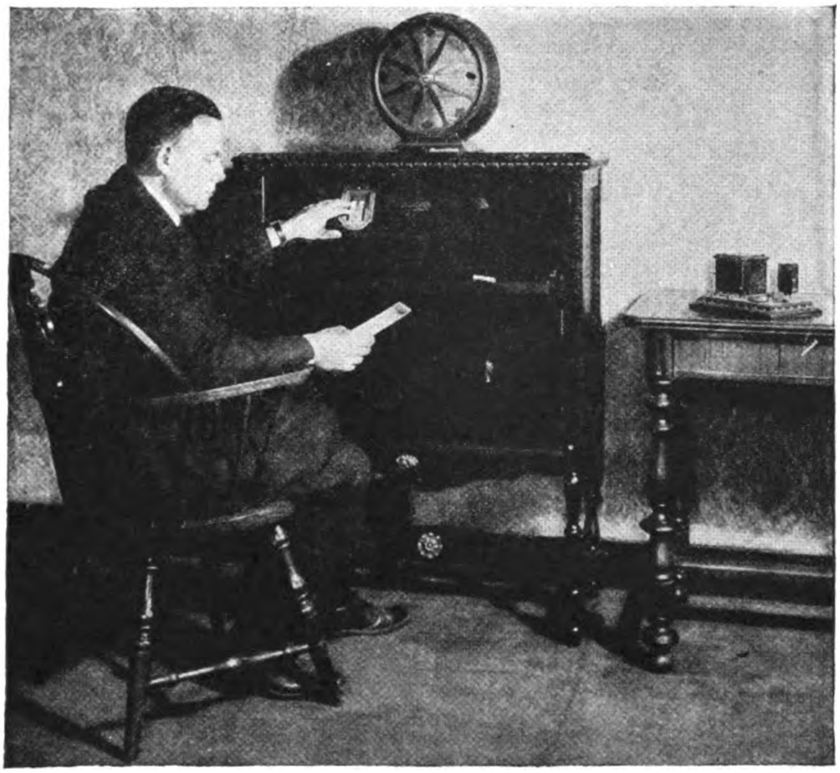
Description: This six-valve receiver employs three stages of tuned high-frequency amplification, a detector and two stages of transformer-coupled, low-frequency amplification.

In external appearance the receiver is somewhat unusual. It conveys an impression of massiveness without actually being so, and this lends an added attractiveness. The entire cabinet is of American black walnut, carefully selected for graining. A hand-rubbed finish brings out the natural beauty of the wood.

The front panel is of the same material as the cabinet and is inset between narrow side panels embossed with decorations finished in bronze. The front panel contains a gold-plated escutcheon plate located slightly above the panel center, and contains the small window through which the calibrated tuning drum is visible. At the lower left-hand corner of the panel is a round wood knob with a gold decoration that controls the combination volume control and filament switch. A similar knob at the lower right-hand corner is the single tuning control.

One of the decided advantages possessed by this receiver is the absolute simplicity of operation. The lower left-hand control knob is given a slight turn to the right to turn "on"

(*Continued on page 470*)



THE COMPLETE LC-28 IN ACTION

The LC-28 high-frequency pack, installed as shown here in a Corbett console cabinet, with the power-pack amplifier in the lower compartment, leaves nothing to be desired, either in quality results or outer appearance of the receiver.

QUALITY AND VOLUME ARE ASSURED WITH THIS

LC-28 AMPLIFIER

Here is the second of a series of articles giving hook-up combinations for the LC-28 high-frequency pack. The Amertran power-pack amplifier, employing the system of amplification that proved so popular with the old LC-27, is used in an improved form to obtain even more astounding results with the LC-28. An additional feature of this hook-up is that it may be used with the new light-socket antennas.

By LAURENCE M. COCKADAY

LAST year there were, literally, thousands of radio fans who built the LC-27 receiver incorporating the famous Amertran low-frequency amplification.

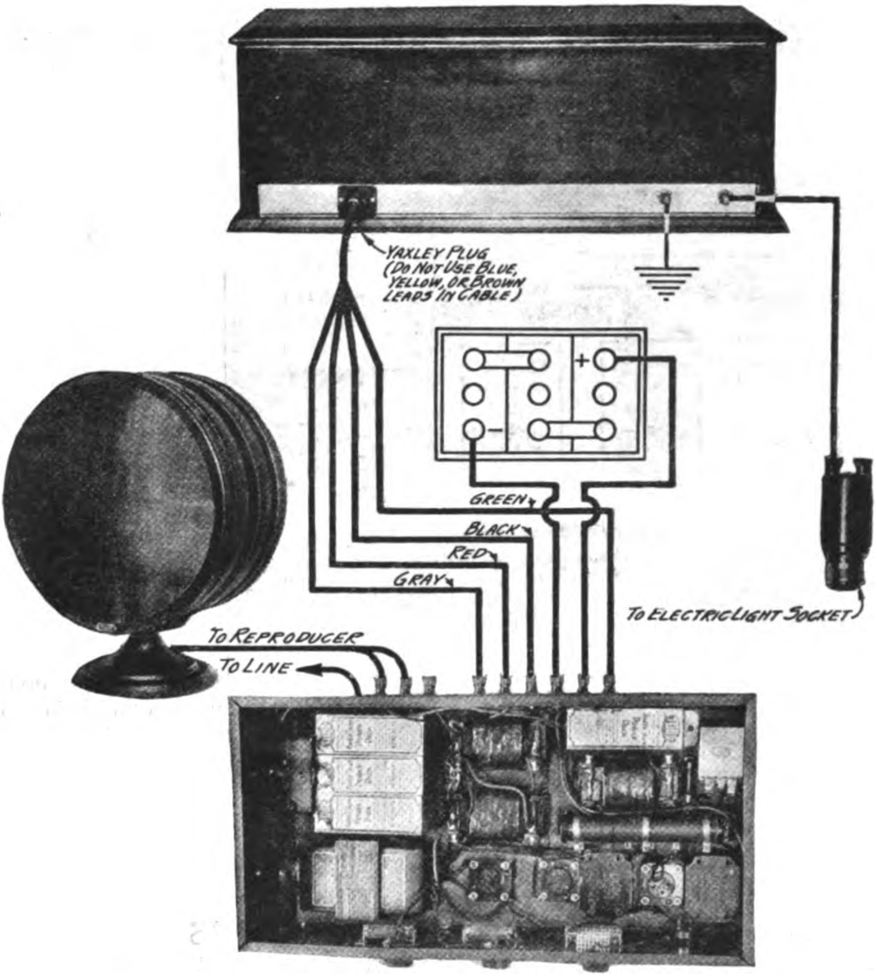
This year there have been numerous requests for a power-pack amplifier for the LC-28 corresponding to that used with last year's set.

In the October, 1927, issue of POPULAR RADIO was described an improved Amertran power-pack amplifier consisting of two stages of transformer-coupled, low-frequency amplification supplied with current through a power transformer and a rectifier and filter system, all completely contained in a neat, metal compartment that shields the instruments and at the same time protects the operator from shock. This amplifier was described as an addition to an old receiver, but works admirably with the LC-28.

When this unit is used with the LC-28 high-frequency pack really amazing results may be obtained in the way of quality of reproduction and volume.

The complete power-pack amplifier carries three control knobs on the front that may be set once and left adjusted. These are the only adjustments that are necessary, and once installed the set will function without any more fuss than turning "on" and "off" the filament switch.

In Figure 1 is shown a combination diagram in the top portion of which is seen the back view of the LC-28 high-frequency pack installed in a standard Corbett cabinet. At the left is shown the Yaxley plug with its leads that connect to four of the binding posts on the power-pack amplifier. The storage battery is connected directly to the power-pack amplifier, and indirectly



HOW TO MAKE THE INSTALLATION

FIGURE 1: *This combination diagram shows the back of the LC-28 pack, installed in the Corbett LC-28 Cabinet. The connection between the Yaxley plug and the power-pack and the single storage battery is indicated in black lines. In this combination a light-socket antenna is recommended; a Temple exponential horn is used for the reproducer. The battery and the power-pack amplifier may be placed underneath the set in the compartment of the radio table.*

through a relay in this unit to the vacuum valves in the set.

At the right end of the set is shown the antenna connection. A light-socket antenna, such as the Dubilier Ducon, is recommended as an antenna, although any other type may be used, if desired.

There are two binding posts on the Dubilier device and it may be found that one or the other is considerably the better for the antenna connection. Or again, it may be found that both of them may be used, connected by a single wire. Also, it may be found that reception is improved by turning "on" the switch of the socket into which the device is inserted. On the other hand, reception may be better with the switch turned "off." This can only be determined by experiment.

Two connections, of course, run from the reproducer to two binding posts on the power-pack amplifier, and the extension cord and plug on the power-pack amplifier is to be inserted in a lamp socket of the 110 volt, 60 cycle lighting lines.

In using the set the switch rheostat on the set itself should be left set at the "on" position all the time. The set should then be turned "on" and "off" by the switch on the power-pack amplifier, which controls all the vacuum valves in the set and the amplifier as well.

In the set-up shown in Figure 1, a radio table with a compartment underneath may be used, with the storage battery and the power-pack amplifier placed in this compartment, and with the Yaxley cable running up the back to the LC-28 cabinet on the top.

In the illustrations a Baldwin "99" reproducer and a Temple exponential horn are pictured as representative of the types of loudspeakers that have been found suitable for use with this type of set. The reproducer should preferably be connected by a long extension cable and placed on the other side of the room from the receiver, or in any other position where the quality of reproduction sounds best.

If a trickle charger is to be used with the storage battery, its lighting plug may be inserted directly into the relay in the power-pack amplifier marked "trickle charger." This will make the battery charging an automatic feature needing no attention or care on the part of the operator except adding distilled water 2 or 3 times a year. The Westinghouse Rectox trickle charger has been found very suitable.

The three adjustments on the front of the power-pack amplifier, spoken about earlier in this article, are intended to control the "C" bias on the first and second stages of low-frequency amplification, and to control the detector plate voltage.

The first control shown at the left in Figure 1 is for adjusting the "C" bias on the power valve in the last stage of amplification, which is a 210 type valve. The center control is for adjusting the "C" bias on the first-stage valve, which may be a standard 201-a type valve. The control on the right adjusts the plate voltage of the detector valve and may usually be set all the way "clockwise."

The adjustment for the "C" bias on the last valve is usually left nearly all the way "anti-clockwise." The center control may be varied and the proper adjustment will probably be found somewhere along the middle of the range.

The use of the new 281 type rectifier valve, in place of the older style 216-b rectifier valve, gives increased "B" voltages and added power for the operation of the 210-type power valve. This results in improved quality and allows a greater volume to be obtained with less distortion than in the unit used with the old LC-27 receiver.

The fact that the power-pack amplifier contains an automatic relay switch greatly facilitates the automatic operation of the receiver as a whole, and takes care of the charging of the "A" battery, as explained above.

The complete apparatus may be assembled as indicated in Figure 1 and installed neatly without unsightly wires or complicated switching arrangements that would have been necessary with the more old-fashioned combinations.

This same apparatus may be assembled in a regular Corbett Console type cabinet, as shown in the illustration at the head of this article, if desired.

When once assembled and adjusted the LC-28 with this power amplifier will give the highest type of reproduction, will be easy to operate for both distance and local reception, and will have an appearance on a par with that of the most expensive of the factory-built receiver.

An *SOS* Message That Sends Itself

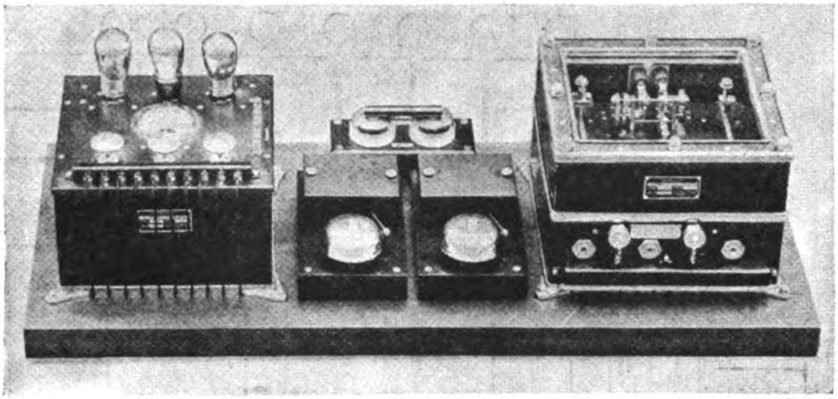
THE tedious vigil of the marine radio operator has been made more or less unnecessary through the perfection of an electric automaton that sends and receives SOS signals. For a number of years the British Marconi Company has been working on the problem of relieving marine operators of the necessity of constant and worrisome vigilance; and this research has culminated in the perfection of a device which not only automatically sends SOS signals, but causes an alarm bell to ring on all ships equipped with the special alarm receiver.

The conventional SOS signal is preceded by a series of three four-second dashes. The receiver is so constructed as to respond only to this combination of extra long signals.

The operator of a distressed vessel need only press a button and there is immediately broadcast a series of these long dashes, followed by the SOS signal so that ships not provided with the special receiver may be warned.

The "key" consists of a clock-driven mechanism which actuates the regular transmitter of the ship through contacts on a segmented drum. The receiver is a three-valve set of a conventional design, the output of which is connected to an especially sensitive relay. This relay controls the local supply of current connected to the electric bells.

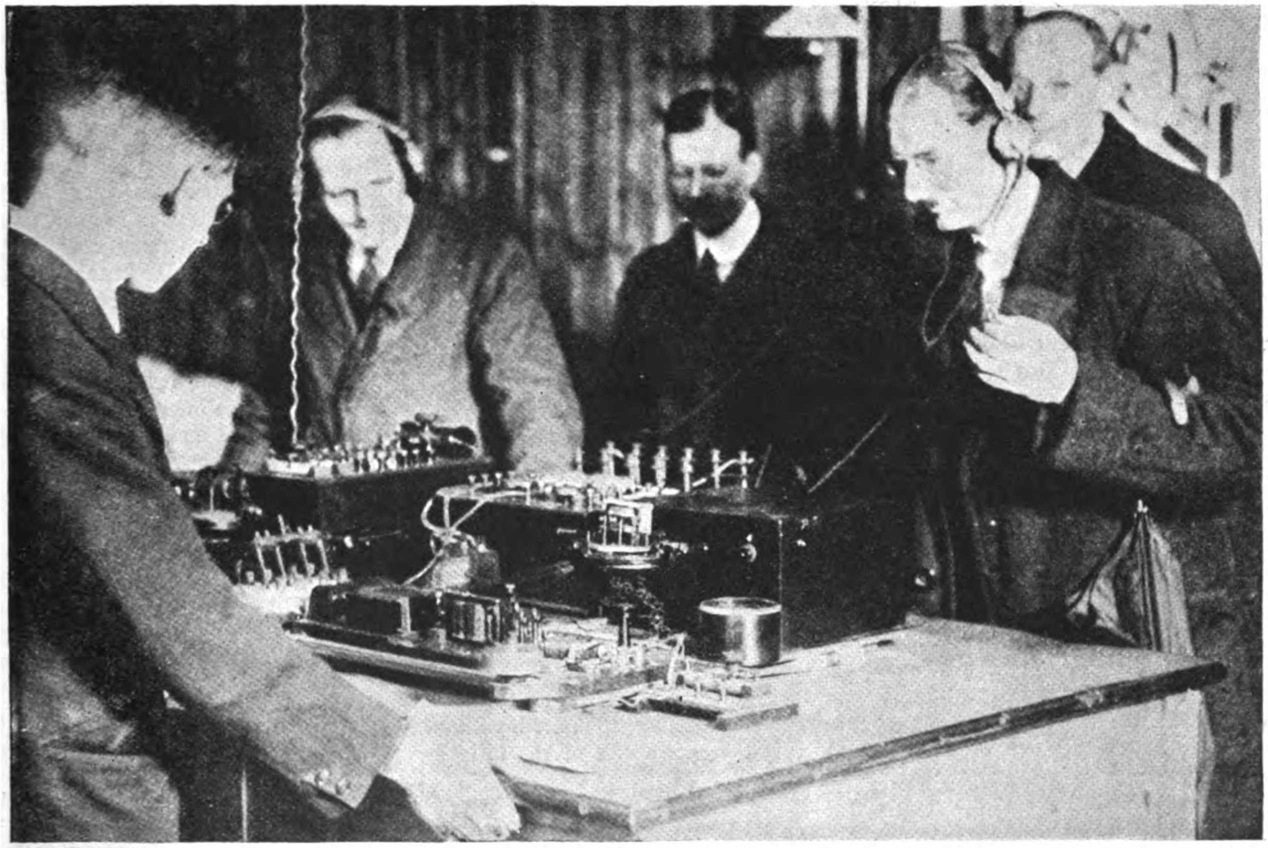
A special selector is used in connection with the receiving instrument and it is the function of this device to properly interpret the four-second dashes, so that it will automatically pick them out of the maze of signals that happen to be vibrating the ether and convert them into the impulses necessary to actuate the relay and, in turn, the electric bell which is located in the operator's cabin.



Kadel & Herbert

A KNOBLESS RECEIVER THAT TUNES ITSELF

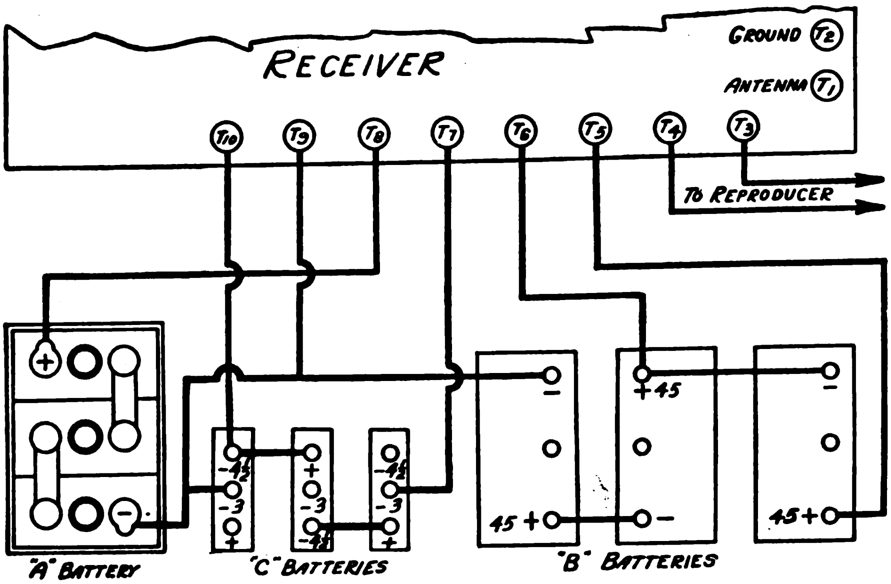
This picture shows the automatic receiver and special relays used to control the electrical current that rings the automatic alarm. The receiver will be seen at the left, and the delicate relays to the right. The alarm bells are between the two instruments.



Wide World Photo

A PRACTICAL DEMONSTRATION OF "HUMANLESS" RADIO

Here is a group of European engineers at an experimental demonstration of the automatic SOS equipment developed by the British Marconi Company. In almost the exact center of the picture one of the sensitive relays used to operate the bells may be seen uncovered.



A REVISED BATTERY HOOK-UP FOR THE RECEIVER

FIGURE 1: *If the "C" battery connections for the Lynch "Five" are carried out as shown in this diagram, there will be a considerable improvement in reproduction as compared with the hook-up given in the article in the November issue of* POPULAR RADIO.

OPERATING POINTERS FOR THE

LYNCH "FIVE"

Here are some hot tips, for the fan and experimenter alike, that will make the Lynch "Five" as phenomenal in operation as it was easy and inexpensive to build.

By S. GORDON TAYLOR

THE low cost and simplicity of construction of the Lynch "Five" receiver, as described in the November issue, will offer a strong inducement to many inexperienced radio fans to try their hands at assembly and construction. To these, and also to more experienced fans who have built this receiver because of its fine tone quality, this article on the operation of the receiver will be helpful. Some worthwhile pointers as to equipment are also incorporated in it.

The directions for putting the Lynch "Five" receiver into operation were given briefly in the November issue and there is no need for repeating them here. However, attention should be called to one change in the battery hook-up. Where the Ce-Co type F semi-power amplifier valve is used in the last low-frequency stage, the "C" bias voltage should be nine and the "C" bias applied to the first and second low-frequency stages should be 1½ instead of 4½ volts. The correct connections are shown in Figure 1.

If the Ce-Co type J-71 valve is to be used in the last stage, the battery connections as shown in the November issue are correct, although even in that case 1½ to 3 volts would be better for the first two low-frequency stages, instead of 4½ volts. If the J-71 valve is used, its greatest worth is obtained by applying 180 volts to its plate instead of 135, and this would call for increase in the "C" voltage to about 40 instead of the 27 volts shown originally.

An output filter should always be used where the plate voltage on the output valve is over 135. It is not necessary that the filter be incorporated in the receiver itself. One such as the National Tone Filter is sufficiently neat in appearance to be placed on the table next to the receiver, if desired, without marring the appearance of the installation.

For all ordinary purposes the type F power valve will be found adequate and it has the advantage of low current drain. With this and the other four valves specified in the original article the total current consumed from the "B" batteries is only 12 milliamperes per hour and the life of a set of standard "B" batteries, according to tables computed with Eveready batteries, will be many months.

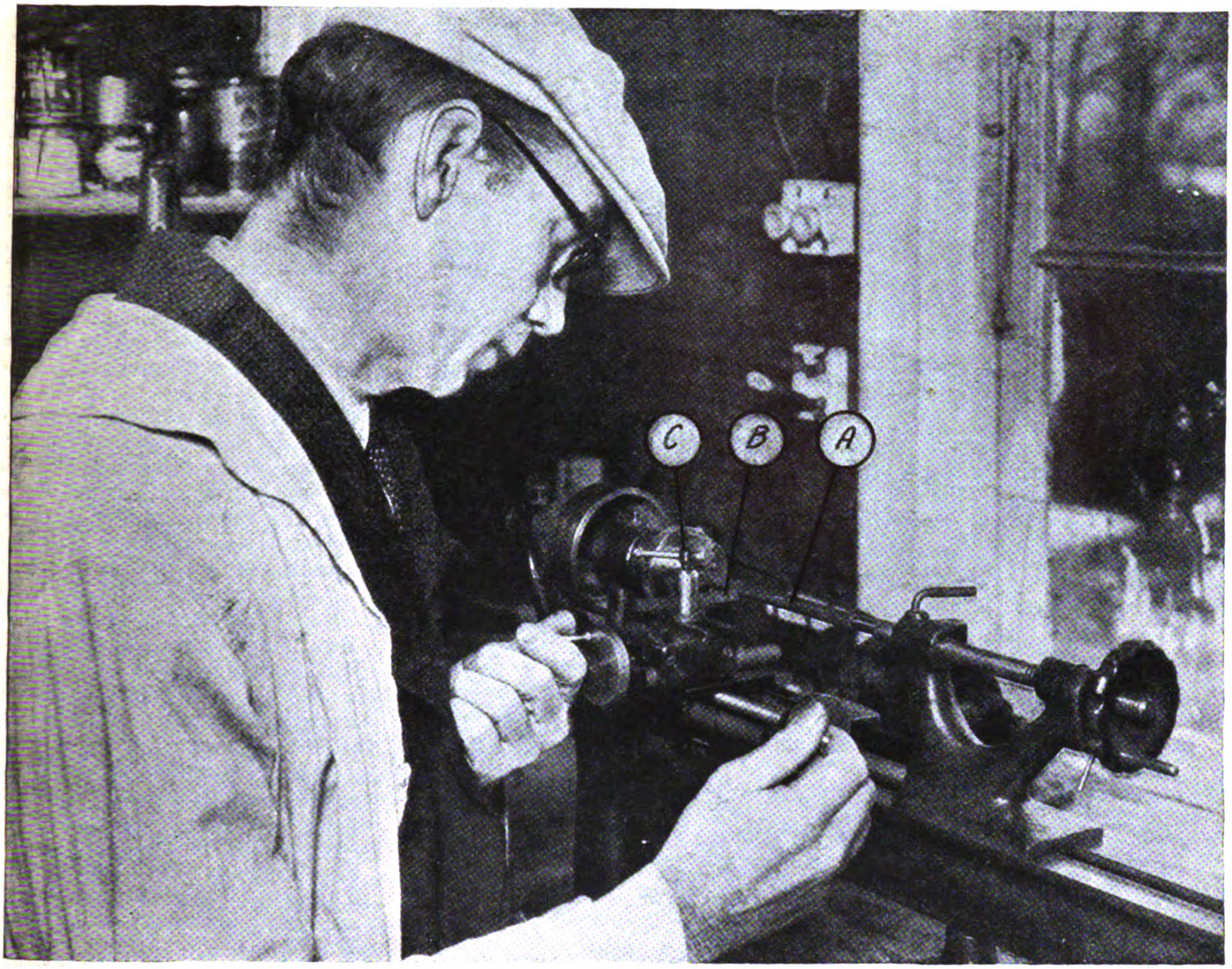
Where the J-71 power valve is used, either a "B" power-pack or heavy duty "B" batteries should be used, because of the higher plate current requirements of this valve.

A combination which constitutes very nearly an ideal filament power source was used with one of the models of this receiver. It consists of a trickle charger and a glass-inclosed storage battery with a built-in charge indicator. The trickle charger used is unique in that it uses neither bulbs nor liquids for the rectifier; it provides a tapering charging rate and it includes a built-in relay switch. The rectifier included in the charger is the new "Drirex" cartridge. With this rectifier the trickle charger requires no attention whatsoever and the rectifier life is practically indefinite and is guaranteed for a minimum of 4,000 hours' service.

In operating the receiver the rheostat should never be turned more than four-fifths of the way "on," otherwise the voltage applied to the valve filaments will be excessive. About two-thirds "on" is a good normal operating position.

If there seems to be an excessive tendency toward oscillation, it will be well to reduce the voltage at the rear terminal, T6, shown in Figure 1, to 67½ volts. This applies a lower voltage to both the high-frequency and the detector valves and will provide just as good results as the full 90 volts in most cases—with lower "B" battery consumption. Tighter coupling in the antenna coupler will also help to stabilize the circuit, particularly where a very small antenna is used.

The best settings for the rotors of both coupling coil units should be found by experiment and then the rotors should be left in that position. Any considerable change in the adjustment of these will change the condenser dial settings for a given wavelength or station, and will therefore interfere with the accurate "logging" of the dial settings. The rotor of the antenna coupler should be adjusted as nearly parallel with the windings of the stator as practicable without sacrificing selectivity. The rotor of the detector coupler should be left in a position a little below that where the detector goes into oscillation. This latter will require some adjustment from time to time to serve as a sensitivity control, but for volume control it is quite as simple to detune slightly one of the tuned circuits.



From a photograph made for POPULAR RADIO

HOW TO TURN DOWN A METAL ROD

FIGURE 1: *Here the operator is shown turning down a rod by the use of the slide rest. "A" is the work to be turned, "B" is the cutting tool and "C" is the tool post which holds the cutting tool tightly clamped in the proper position.*

Your Laboratory Tools

ARTICLE NO. 4

The metal-turning lathe puts the ingenious home experimenter on equal terms with the manufacturer, as far as accuracy and quality in metal work goes. This article tells the experimenter how to use it.

By LOWELL MADDEN, JR.

ALTHOUGH metal-turning on a lathe may strike the novice as being very easy, there are a number of details that have to be mastered before proficiency or anything like accuracy may be attained.

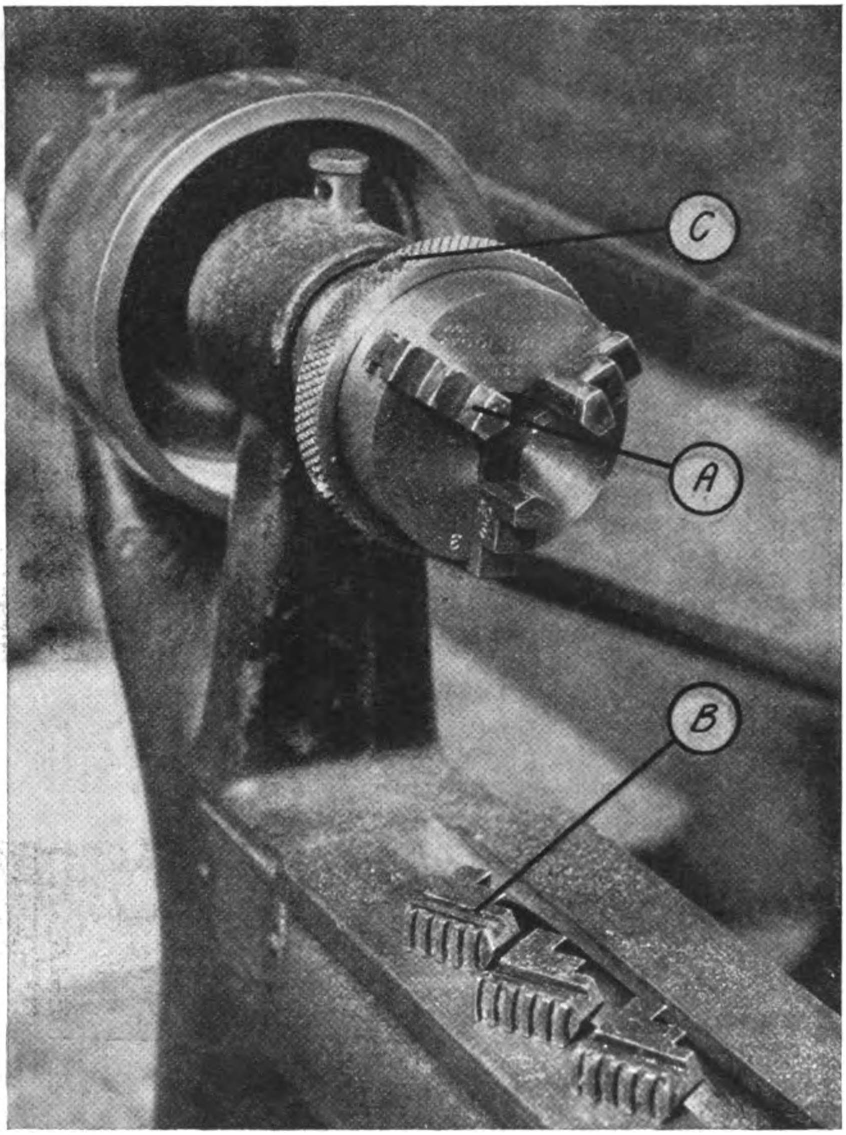
True, the principle of turning is simple; perhaps even the rankest dabbler could chew a piece of metal out on a lathe—but he would have much to learn and much experience to gain before he would gain skill enough to call himself even a third-rate machine hand.

This remark, however, should not tend to dishearten the beginner, providing he doesn't assume too much and is willing to take a few practical suggestions.

It is presumed that the reader knows that turning is accomplished on a lathe by the aid of a cutting tool coming in contact with metal revolving in the lathe.

Naturally enough, the lathe tool must always be harder than the metal being cut. One could not hope to cut down a file, for instance, because files are made out of extremely hard steel, and the ambitious turner of files would find that the edge of his lathe tool would be worn off as fast as he sharpened it. The lathe tools purchased on the market, and especially those provided for use with this particular Goodell-Pratt lathe, are sufficiently hard to cut any of the common metals except hardened steel. Cold rolled steel, which is comparatively soft, is easily machined.

Before a piece of work can be mounted for turning, the operator must



THE SCROLL CHUCK READY FOR WORK

FIGURE 2: *Here is a little scroll chuck mounted on the live spindle. The knurled ring, "C," is used to cause the chuck jaws, "A," to move in and out. At "B" the reader will see illustrated the outside jaws of the chuck, which may be inserted for the purpose of holding larger work.*

provide means for centering it in the lathe. It should be understood that bearing surfaces must be produced so that the work will revolve between centers without danger of chattering or moving out of position. Where accurate work is essential, good centers are extremely important.

Perhaps the first warning to impress upon the experimenter is the obvious possibility of making the wrong kind of a center hole.

We see this illustrated at A in Figure 6. This is the kind of a center that would result if the workman used an ordinary drill for the center hole. As the illustrations shows, the bearing surface will be very small; after making a few revolutions this surface will wear down and the piece revolving in the lathe will have a tendency to chatter and to work itself out of position when the cutting tool is brought in contact with it. Even the superficial student of metal working will see that it is impossible to turn the work accurately if this condition exists. It is bad not only for the work but for the dead center as well.

There is such a thing as a "centering drill." This is a special drill which produces a conically-shaped hole or bearing surface that corresponds exactly with the angle of the center, thereby providing a bearing surface similar to that illustrated at B in Figure 6. Such a bearing, well oiled and with the dead center pressed tightly into it, is necessary for accurate turning.

But how is the mechanic to find the exact center of a piece of rod, for instance?

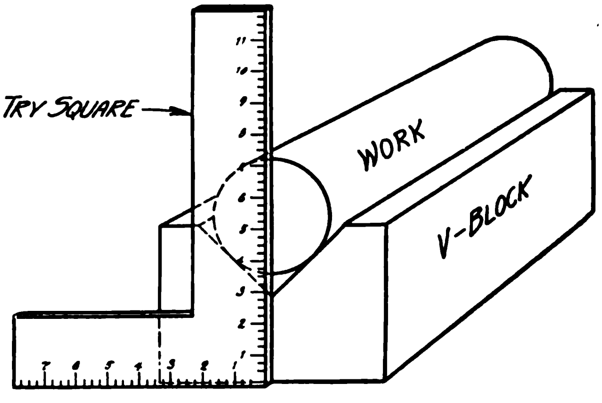
This must be done before the centering drill can be employed. Of course, when a heavy cut is being made along the entire length of a rod it is not so important that the exact center should be found, as the work will center itself after the cutting progresses.

For such a center, the kink illustrated in Figure 7 may be employed.

Here four lines are scratched on the end of the work by the use of a compass. The mechanic may then find the approximate center of the area enclosed by these scratches.

Another good method of locating the approximate center and a method more accurate than the one previously described is presented in Figure 9. Here what is known as a "bell center punch" is employed. The use of this is so obvious that no further description will be necessary.

A third method, and one that is perhaps as accurate as any, is shown at Figure 3; here what is known as a "V-block" is used. The rod is placed in the groove of this block and a square is brought into position so that it lines up with the exact bottom of the groove. A scratch is made on the end of the rod and the rod is then turned approximately 90 degrees and another scratch made. Almost the exact center will be found at the point where these scratches intersect.



FINDING THE CENTER WITH A V-BLOCK

FIGURE 3: *By scratching two lines at right angles to each other, almost the exact center of a round rod may be found.*

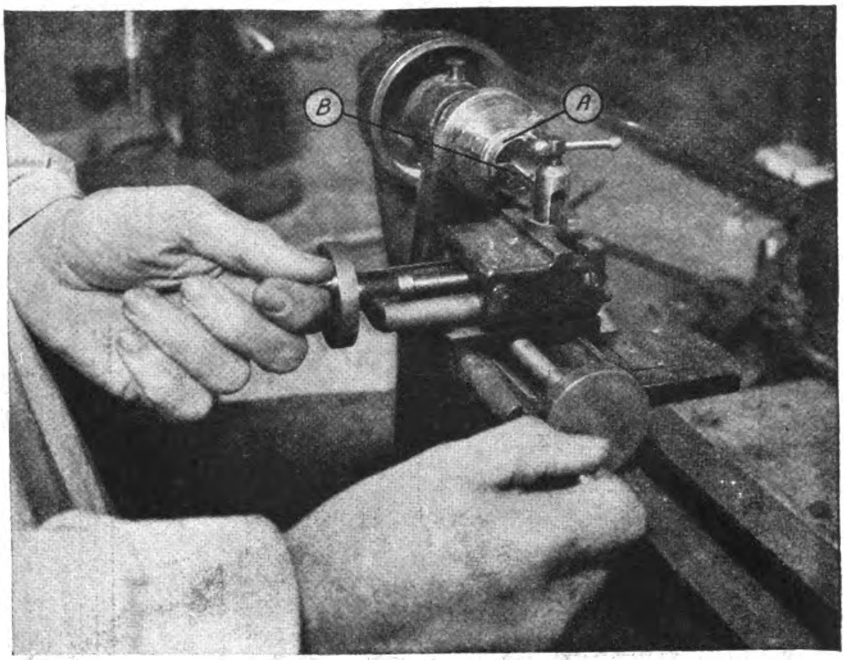
Figure 1 shows how the work is mounted between the lathe centers. First the slotted face-plate is screwed in place on the live spindle of the lathe. One of the two lathe dogs (which were described in the second article of this series) is placed over one of the ends of the rod. The projecting arm of the lathe dog is permitted to rest in one of the slots of the face-plate and the large center (that is, the live center) of the lathe is inserted in the live spindle. Naturally the opposite end of the rod is held in position by the dead center. A good dose of oil should be placed on the dead center bearing.

The next job in the work of arranging the set-up for turning is that of putting the slide rest in place. A clamping bolt which projects up through the center of the lathe bed and emerges in a slot in the bottom of the slide rest is used for this purpose. This slide rest is made up of three principal parts; one is held permanently to the lathe bed by the clamping bolt just mentioned. The position and movement of the other two parts are controlled by two feed screws; one moves the cutting tool parallel to the axis of the work revolving in the lathe and the other moves at right angles to it. Thus the tool may be moved up and down the work and into the work.

There is a slot provided on the top of the slide rest for the tool post. The tool post is that part of the slide rest which grips and holds the cutting tool in the proper position. Close examination of the Figure 1 will show that the tool post is also provided with a clamping screw. Means are also provided so that the angle of the cutting tool may be adjusted. (The importance of this adjustment will be discussed later.)

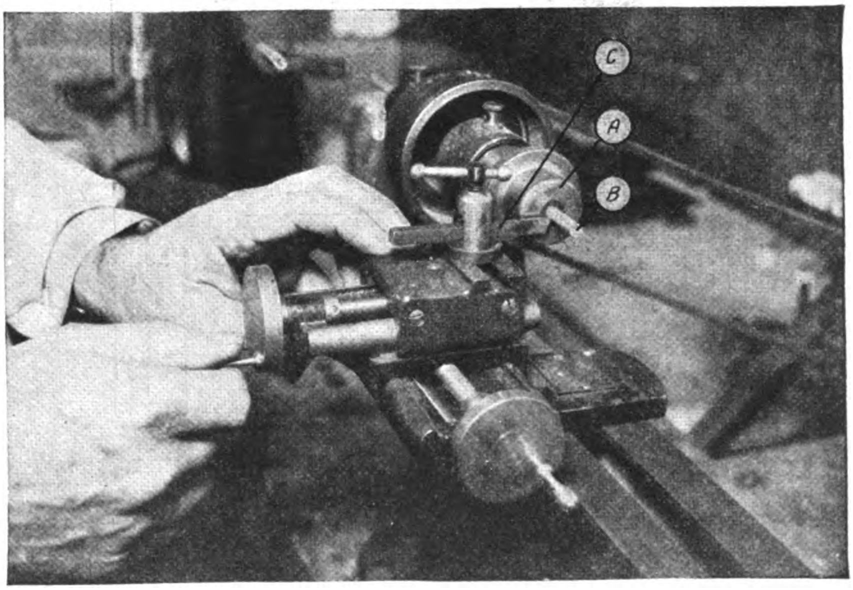
A good mechanic always examines a lathe tool before he uses it. First, he wants to know if it is shaped correctly, and secondly, he wants to assure himself that it is sharp. If it is not sharp he must know how to sharpen it. The first thing to learn in sharpening a tool is not to burn it. If it is left in contact with the grinding-wheel for too long a period it will turn blue and lose its hardness. A small receptacle of water

(*Continued on page 456*)



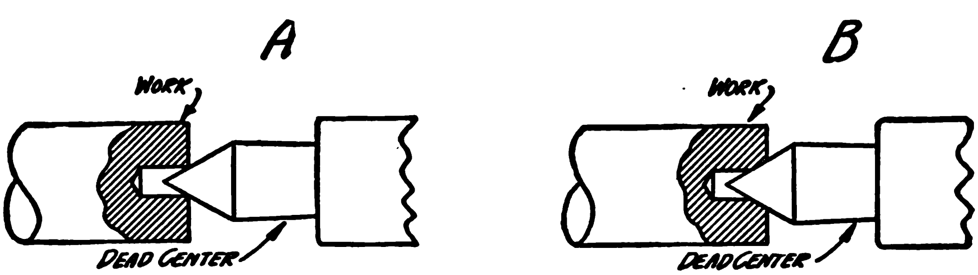
USING A SCROLL CHUCK FOR INSIDE TURNING

FIGURE 4: *Here the scroll chuck is used to grip a large brass tube, the inside of which is to be turned down. "A" is the work and "B" the cutting tool which, in this case, takes the form of a boring tool with the cutting edge at right angles to the body of the tool.*



MAKING USE OF THE COMPRESSION CHUCK

FIGURE 5: *Here the compression chuck is being used to cut off lengths of metal rod. The rod to be cut is illustrated as "B," while "A" is the compression chuck and "C" the cutting-off tool.*



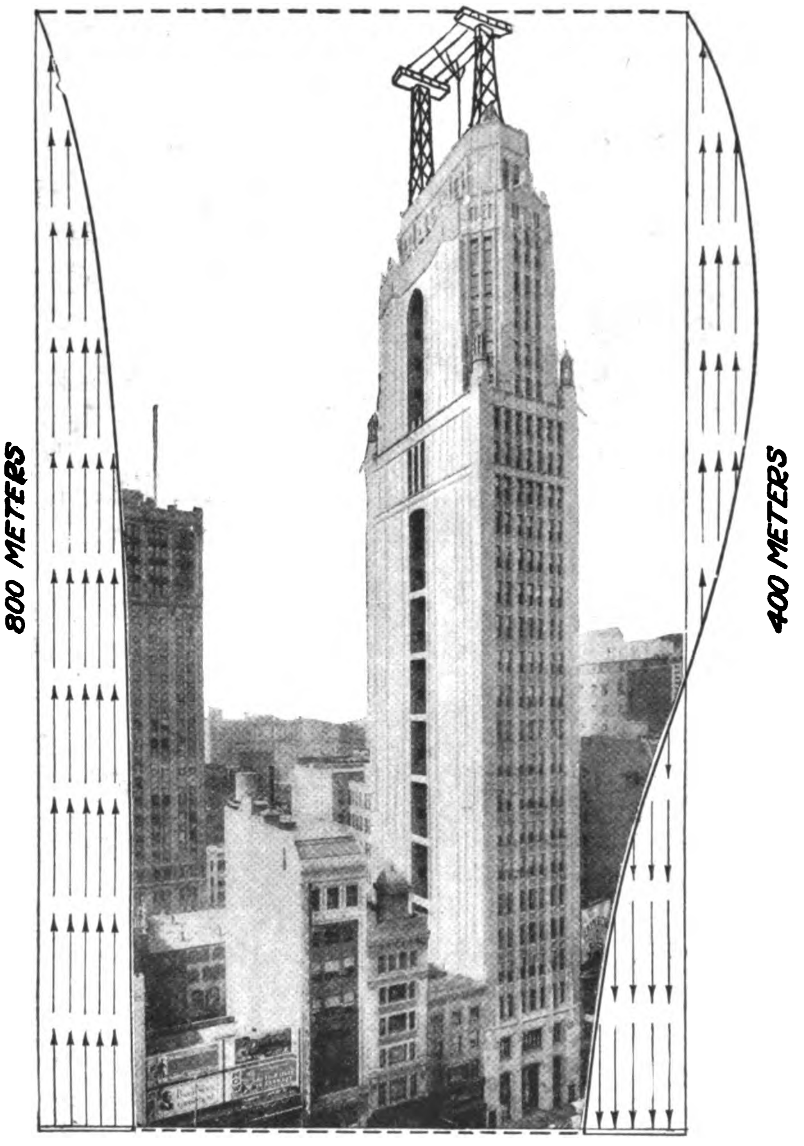
HOW WORK IS CENTERED ON A LATHE

FIGURE 6: *At "A" the incorrect method of providing bearing surface is illustrated, while at "B" the proper method is shown.*

If You Live in a Building

Electrical energy radiated from broadcasting stations is absorbed by modern skyscraper construction—which directly affects radio reception. This article tells how experiments are locating and removing this particular problem of the listeners.

By R. W. KING



HOW A SKYSCRAPER MAY REINFORCE OR IMPEDE RADIO WAVES

FIGURE 1: *A building such as the above one, that employs a steel supporting framework, acts as a secondary antenna for transmissions broadcast from its roof. If the wavelength of its natural frequency corresponds to the wavelength of the broadcasting antenna, the rein forced wave at the left is the result. If the two are out of phase, the result is poor transmission efficiency, as indicated on the right.*

TO the broadcast listener in the city, one of the most vital factors in radio reception is the effect of tall steel buildings upon reception.

During the past few years, while the American Telephone and Telegraph Company was interested in broadcasting, its engineers made an extensive study of these problems* and many of their data are now in a form suitable for publication. These studies divide into two parts; first, the effect of tall buildings on the location of a transmitting station, and second, the effect of these buildings upon the individual receiving set.

The location which naturally suggests itself for a broadcasting station intended to serve the city is its center. A central location might be expected to deliver waves of the greatest strength to the greatest number of listeners.

The erection of a broadcasting station in the heart of a large city ordinarily means, however, that its antenna must stand on the top of a tall steel building. This has been done for a number of stations in various cities. Station WBAY was probably the first of this kind; it was originally erected on top of the twenty-four story long-distance telephone building at 24 Walker Street, New York City.

With this location it was found that with the limited wavelength range then open to broadcasting, radiation from the antenna was relatively poor. Careful measurements of the signal strength as received at a testing laboratory some 30 miles away (Cliffwood, N. J.) gave the results shown in Figure 4.

The wavelength upon which WBAY was operating as a broadcasting station was 400 meters. For the purpose of conducting the tests summarized in Figure 4, an experimental license was obtained, permitting operation over a rather wide range of wavelengths. As the curve shows, the signal strength radiated from WBAY was variable and dropped to a very low value at 400 meters. This was exactly the wavelength assigned to the station for broadcasting purposes. When it became possible to shift to a longer wavelength, radiation was, of course, greatly improved, as indicated by the curve.

The study made on this station was the first to disclose the fact that it is possible to have the supporting building too high for the efficient radiation of certain frequencies.

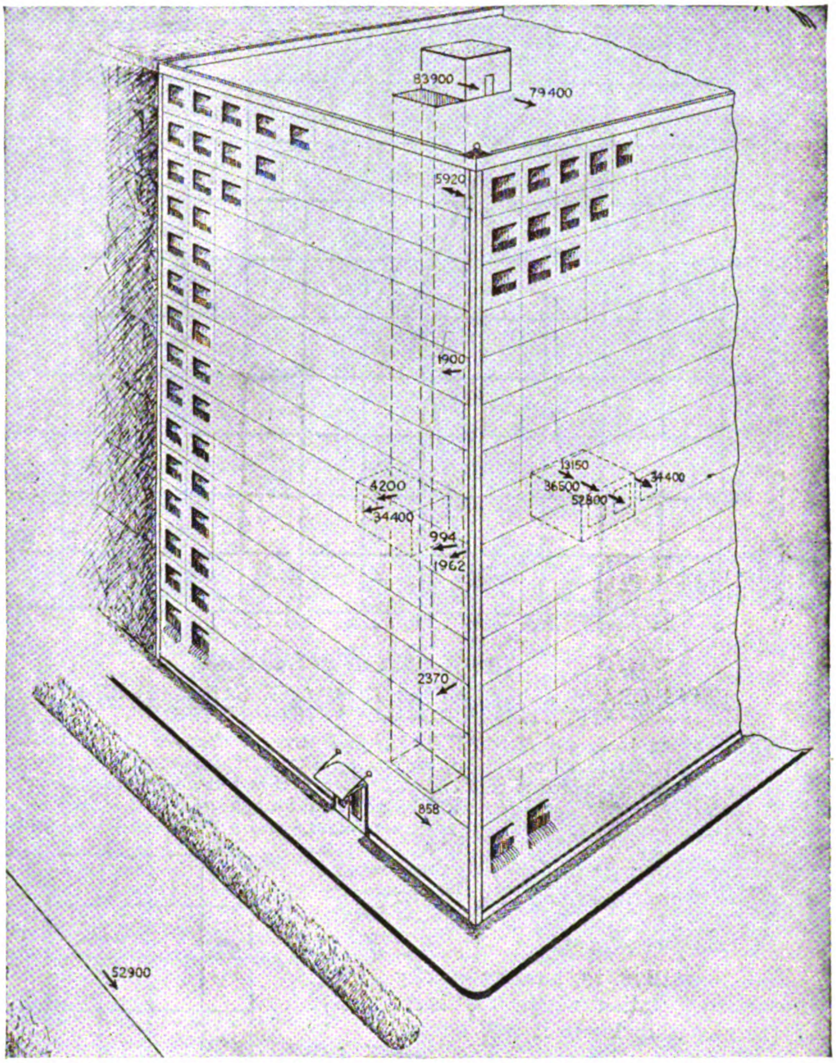
The electrical action of a tall steel building with respect to radio waves may be explained as follows:

City skyscrapers are immense steel cages or skeletons which are good conductors of electricity and form a suitable path for the flow of high-frequency electric currents. As electromagnetic waves are radiated from an ordinary antenna on the ground they advance outward and upward and touch the ground at their lower ends. At some

---

* See "Radio Transmission Measurements," by Bown, Friis and Englund, *Proceedings, Institute of Radio Engineers*, Vol. 11, 1923, and "Radio Broadcast Coverage of City Areas," by Espenschied, *Bell System Technical Journal*, Vol. 6, 1927.

With a Steel Framework—



American Tel. & Tel.

HOW STEEL FRAMES ABSORB ELECTRICAL ENERGY

Figure 2: *An apartment house of this type that employs a heavy steel framework acts as an absorber of electrical energy from broadcasting stations, with the result that inside the building the field strength of a broadcasting station signals is only a small fraction of the field strength outside. The figures show the signal strength in microvolts per meter, as received in various parts of the building. Note how little energy reaches the inside rooms around the elevator shaft.*

distance from the station the wave fronts become practically vertical and the waves travel on, outward, with their feet on the ground and their heads somewhere above the clouds.

Now, when a station is situated on the top of a steel building the waves travel *down* the building as well as out horizontally. As they approach the ground, part of the wave energy is reflected back up the building and then interacts with later waves coming down.

The result is the formation of large oscillatory currents in the building structure; the distribution of these currents is determined by the height of the building and the wavelength of the radiated waves. If the dimensions of the building are such that one of its natural or free periods of oscillation corresponds closely to that of the wavelength one undertakes to transmit, it follows that the frame of the building, like any coupled resonant circuit, will draw heavily upon the power of the transmitter.

But, in addition to this, the building apparently acts as a secondary antenna, radiating a wave which may be more or less in or out of phase with the wave from the real antenna. If the two waves are out of phase, the net result at any distant point is, of course, a field strength less than that due to the single wave from the real antenna. On the other hand, if they are in phase, they augment each other and the real antenna shows up as being unusually efficient. Figure 1 illustrates this graphically.

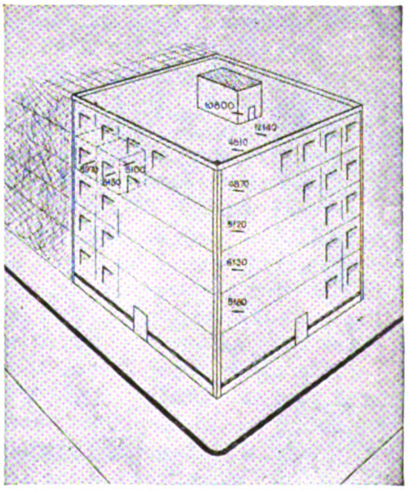
Both of these conditions have been observed with signals sent from WBAY, as Figure 4 shows. In the neighborhood of 400 meters, the antenna was quite inefficient, while at about 800 meters it proved to be efficient.

As a result of the measurements made on WBAY, it was possible to predict the occurrence of a similar effect in the case of the antenna which the City of New York desired to erect on the Municipal Building. Temporary antennas were therefore erected and the signal strength from them was measured at the same testing laboratory at Cliffwood, N. J., using a small transmitting oscillator of 100 watts. The result of these measurements is given in Figure 5.

Radiation was found to be a minimum in the vicinity of 360 meters, which was very nearly the wavelength which was to have been assigned to the completed station. The station is now operating on 526 meters, which is seen to be well up on the radiation curve.

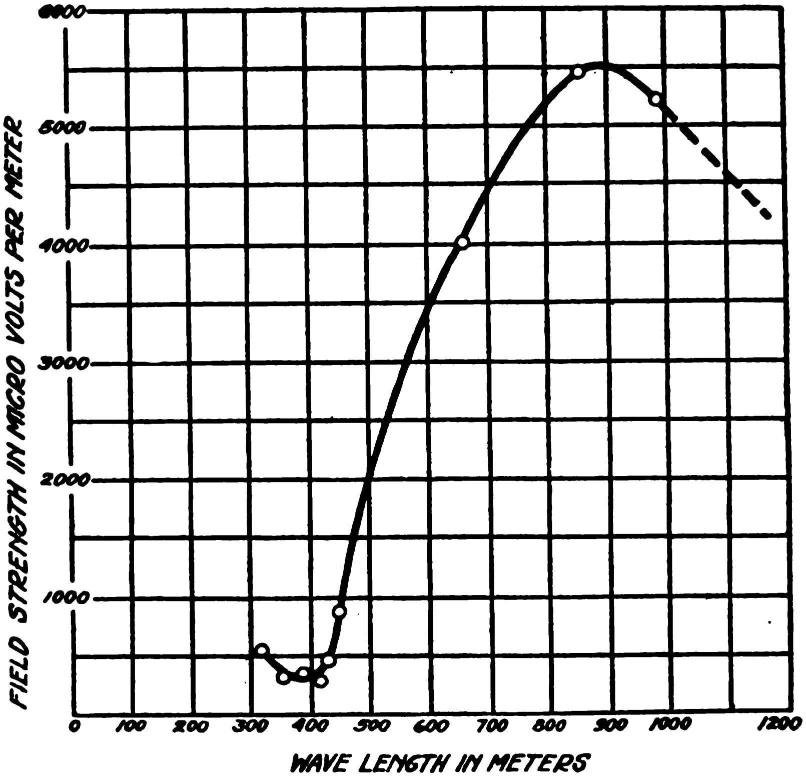
In both Figures 4 and 5 the signal intensity has been expressed in terms of microvolts per meter.

In the case of both the Walker Street telephone building and the Municipal Building, experiments were made with a number of different antenna arrangements and with different methods for exciting the antenna and obtaining the ground connection. None of the modifications, however, materially affected the frequency of minimum radiation. Measurements made upon lower build-



RECEPTION IS BETTER WHERE NO STEEL FRAMEWORK IS USED

Figure 3: *This apartment house does not have a steel framework. Note that the reception inside is never less than one-half of that in the penthouse on the roof, while in Figure 1 the reception at some inside points is as low as 1 per cent of that on the outside.*



THIS GRAPH ILLUSTRATES HOW ONE STEEL BUILDING AFFECTED A BROADCASTING STATION

Figure 4: *At 400 meters WBAY'S field strength dropped to a minimum, due to absorption of energy by the steel framework of the building on which it was erected. At a higher wavelength the steel structure reinforced the wave energy and brought the field strength to a maximum.*

ings have shown that, for the usual broadcast wavelengths, heights of the order of two hundred feet are entirely satisfactory.

The alternative to locating a city broadcasting station within the heart of the city is to locate it well outside and provide it with such power that it can lay down a strong and fairly uniform field throughout the city itself.

Here again the presence of tall buildings asserts itself. These buildings are good absorbers of radio waves and therefore cast long shadows. The existence of such shadows has been recognized since the early days of broadcasting and has been described in other articles,* but to recall briefly the nature of the effect the reader is referred to Figure 6. The data represented in this figure were gathered by means of a portable radio transmitter on the one hand and a portable receiving and measuring set on the other. For the test shown, the transmitting station was located at College Point, Long Island, while the receiving set was carried on circuital tours around the transmitter. It will be noted that the tall structures of Manhattan Island throw a very decided shadow over into New Jersey.

The variation in field strength indicated in Figure 6 of course discloses the distribution as measured in streets and open places. It does not disclose the signal intensity in the immediate vicinity of any indoor receiving set.

Perhaps the most difficult situation is that of the large apartment house, particularly where it is desired to receive by means of an indoor antenna. Two effects are here encountered:

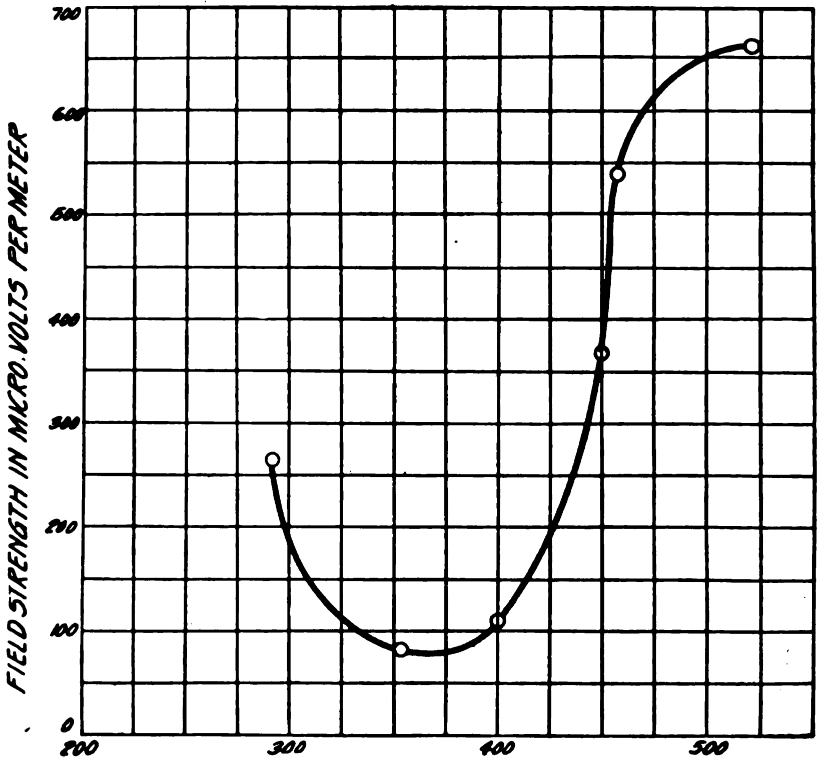
First, the reduction in signal strength because of the shielding effect of the building; and;

Second, the existence of a relatively high noise level caused mainly by high-frequency interference from electrical systems within the building.

In general, it may be said that the chances of good reception in apartment houses are in favor of the man who pays the lowest rent. The four or five story walk-up apartment without elevator and without steel frame exerts no very serious influence upon radio reception within it. Measurements made upon a typical house of this type are given in Figure 3.

It will be noted that observations taken at the various landings of the stairway, which rises at about the center of the building, are only half as great as that taken out in the open on the roof of the building. Signal

(Continued on page 472)



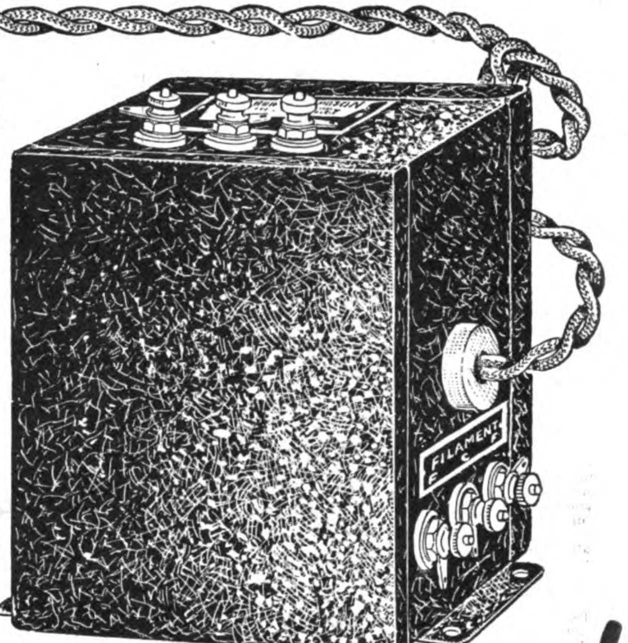
HOW A TRANSMITTER WAS "TUNED" TO A SKYSCRAPER

Figure 5: *This chart shows how the broadcasting station on the Municipal Building in New York City was out of phase with the steel structure at 350 meters and in phase at about 550 meters.*

---

* See Popular Radio for September, 1925.

Build Your Own Power Amplifier



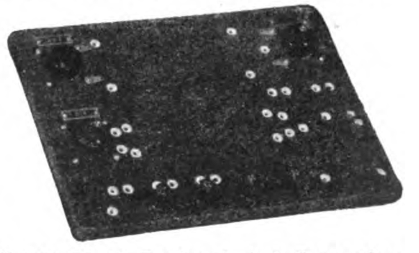
Transform your Receiver into a Real Musical Instrument!

R-210 Power Compact . $20

With a screw driver, a pair of pliers, and a soldering iron you can build a Thordarson Power Amplifier and B-supply in your own home that will equal the finest commercial amplifier on the market. Complete constructional booklet and simple diagram accompany every transformer.

Thordarson R-210 Power Compact

The Thordarson R-210 Power Compact is scientifically designed to give maximum electrical efficiency and to make home assembly of power amplifiers as simple as possible. The R-210 Power Compact is the foundation unit and contains the following apparatus: (1) A power supply transformer designed for UX-216-B rectifier; (2) Two filter chokes of 30 henries inductance and 65 M. A. current carrying capacity; (3) A 7½ volt supply center tapped for the filament of one UX-210 power tube. Wiring of the complete amplifier is simple—20 leads complete the assembly.



R-211 Metal Baseboard, including sockets, binding posts, mounting screws, and hook-up wire $5

New Metal Baseboard for R-210 Compact Amplifier

To further simplify home construction of the R-210 type amplifier, you can now buy this new crackled finished metal baseboard. All spring sockets and binding posts are mounted and included in the list price. All mounting holes are drilled. All holes for sub-panel wiring are carefully insulated. Location of all sub-panel wiring is marked under baseboard.

R-171 Power Compact . $15

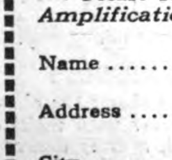
R-171 Power Compact

This power compact is similar to the R-210 type, but is adapted for home construction of power amplifiers using the Raytheon BH rectifier and UX-171 power tube. Designed to meet the popular demand for a low priced yet highly efficient power amplifier. Delivers 320 volts either side of center to the Raytheon BH rectifier. The two choke coils are rated at 85 M. A. 30 henries. The filament winding of 5 volts center tapped is suited to one UX-171 power tube. Two 0.1 Buffer Condensers are also included in the case. Wiring the complete amplifier and B-supply is merely a matter of connecting 18 leads.

No. 2098 Power Supply Transformer . . $20

T-2098 Power Supply Transformer—T-2099 Double Choke Unit

Here is an extra heavy duty power amplifier supply that will satisfy the most exacting demands for excess power. An amplifier using this transformer and choke unit will deliver 425 volts at 130 M. A. drain, sufficient for the heaviest receiver using two UX-210 tubes in power push-pull. Transformer T-2098 delivers 550 volts each side of center tap and is designed to supply two UX-216-B rectifiers (full wave). The 7½ volt filament supply will easily handle two UX-210 power tubes. The double choke unit T-2099 consists of two 30 henries 130 M. A. choke coils mounted in a compound-filled case.



THORDARSON ELECTRIC MFG. CO.
500 West Huron St., Chicago, Ill.

Gentlemen:

Please send me a copy of your free booklet *"Power Amplification Simplified."*

Name ....

Address ....

City.............................. State...........

(3571)

← Get this FREE Book!

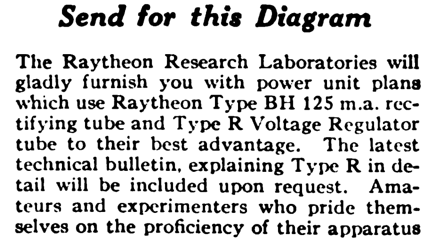
THORDARSON POWER COMPACT

No. 2099 Double Choke Unit $14

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer Specialists Since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

Raytheon Type R Voltage Regulator

For improvement in both the construction and performance of light-socket power units here is the tube to use! When incorporated in the proper circuit, Type R maintains constant voltage on the 90 and lower volt taps and greatly improves regulation on the 180 and 135 volt taps *regardless of changes in line voltage or load current.*



Send for this Diagram

The Raytheon Research Laboratories will gladly furnish you with power unit plans which use Raytheon Type BH 125 m.a. rectifying tube and Type R Voltage Regulator tube to their best advantage. The latest technical bulletin, explaining Type R in detail will be included upon request. Amateurs and experimenters who pride themselves on the proficiency of their apparatus will want to build and own this perfect power unit. Write today.

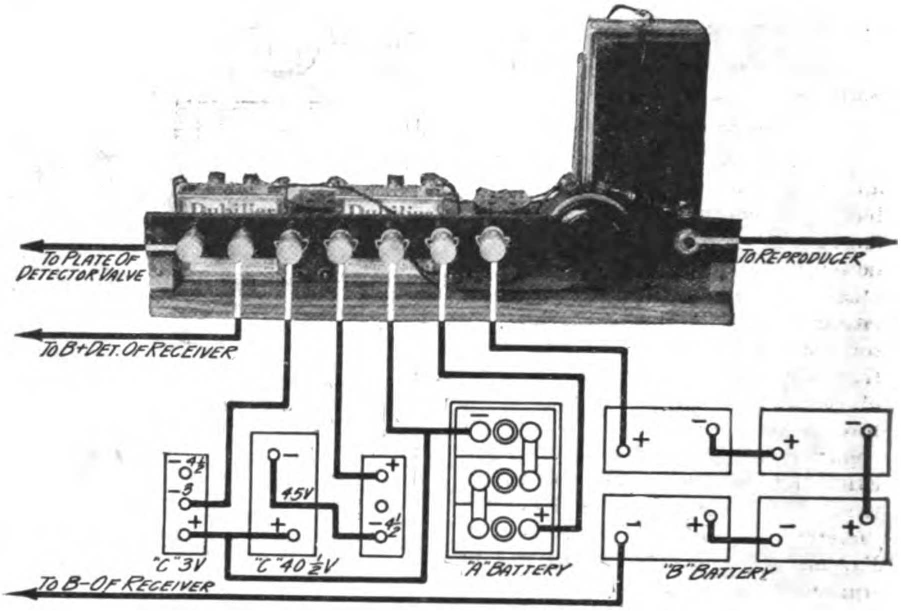
Type R	**Type BH**
90 Volts. 60 m.a.	**125 m.a. at 300 Volts.**
Price $4.00	**Price $4.50**

RAYTHEON MANUFACTURING CO.
303 Kendall Square Bldg., Cambridge, Mass.

Raytheon
LONG LIFE RECTIFYING TUBE

An Amazing Discovery in Resistance-Coupled Amplifiers

(*Continued from page 420*)



HOW TO HOOK UP THE AMPLIFIER

FIGURE 4: *With the amplifier hooked up to the batteries indicated in this diagram, amplification of surprising quality may be obtained.*

Next fasten the two single mountings, C and D, in position.

Then place the two condensers, M and N, against the single mountings and fasten with round-head brass screws.

Secure the amperite mounting with a flat-head brass screw.

Next place the low-frequency choke, O, with the terminals "away" from the binding-post strip and fasten down with two round-head brass screws.

Using the brass strap, Z, secure the large condenser P in position.

This completes the placing of the base-mounted instruments with the exception of the small coupling condensers, K and L, which should later be held by the wiring.

Mount the rheostat, U, the jack, Q, and the seven binding posts on the binding-post strip, X, and secure the strip on the baseboard with the small brackets, Y.

The wiring should be done exactly as shown in Figure 3. When the wiring is completed insert the plate-coupling resistances E and F, the grid-leaks, G and H, the filter resistors, I and J, and the amperite T in the proper mountings as shown in Figure 3. The instrument is then ready for installation.

How to Install the Amplifier

Connect the amplifier into the detector-output circuit of the receiver with which it is to be used and to the proper batteries as shown in Figure 4.

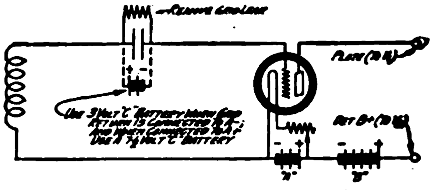
Insert a CX-340 valve in the detector socket and first low-frequency socket, R, of the amplifier, and a CX-371 in the last stage socket, S.

The CX-340 detector valve and the first amplifier need a high value of plate voltage, and the "B+" detector binding post of the receiver (normally connected to the 22 or 45-volt "B" battery terminal) should be connected to the highest amplifier voltage available, which will be that used on the last valve.

The detector valve will work best with "C" bias detection. If a grid-leak and condenser are used it is suggested that the grid-leak be removed and a "C" battery inserted across the grid condenser as shown in Figure 5. The bias should be three volts if the detector grid return is connected to "A—" and 7.5 volts if it is connected to "A+." If there is any uncertainty about the connection, try these two values.

The detector and first low-frequency valves can be burned very low. In fact, results will generally be satisfactory when the pointer of the 20-ohm rheostat just touches the first wires of the rheostat.

No difficulty at all was experienced in operating this new amplifier and the volume and quality have been found to be excellent. The amplifier can be highly recommended to all who are looking for better low-frequency amplification at small expense.



FOR BETTER RESULTS

FIGURE 5: *This diagram shows the changes to be made in the receiver with which the amplifier is to be used, if it is desired to get the best possible results by the use of "C" bias detection.*

The Hammarlund Hi-Q "Six"

(Continued from page 436)

attention other than the addition of water two or three times a year.

Regarding a Reproducer

A number of excellent loudspeakers are now on the market which are capable of reproducing the entire range of musical frequencies. Some of these, however, bring out the high notes while others give preference to the low or intermediate tones, which is the reason that some loudspeakers work better than others with a particular set. This, of course, as explained many times before in POPULAR RADIO, is due to the combination of the amplifier characteristics and the loudspeaker characteristics. The designers of the Hi-Q Six, therefore, recommend the use of the Farrand oval-tone reproducer, or its equivalent, in connection with this receiver.

Antenna Considerations

The set may be used with an outdoor or indoor antenna of almost any size. Most efficient operation will probably be obtained with an antenna of about 75 feet in length for both local and distance reception.

The Hi-Q Six has such a large value of amplification, however, that it may be connected to a standard light-socket antenna without the bother or fuss of putting up an outdoor antenna.

For this use the Dubilier Ducon unit may be screwed into any convenient lamp socket and a wire run from it to the antenna terminal on the set. Excellent reproduction and plenty of volume will be obtained, and in nearly all cases distance reception has been found to be satisfactory with this antenna. The use of this device, of course, eliminates a lot of unsightly wiring both inside and outside of the house. The battery hook-up in Figure 1 shows the proper installation for this unit.

If the set builder requires more information regarding recommendations as to power apparatus, loudspeakers, antennas, "B" batteries and storage batteries or voltmeters, in connection with the new set, he may obtain a complete construction and operation manual from the manufacturers.

In tests in the POPULAR RADIO LABORATORY the new receiver has come forth with flying colors, both for its simplicity in tuning and the excellent quality of reproduction that may be obtained with it. And the appearance of the receiver when mounted in a console, as pictured at the head of this article, will fit in with the best home furniture.

In the January number, POPULAR RADIO will publish an article telling how to build and install the official Hi-Q power-pack, that will supply "B" and "C" voltages for the Hi-Q receiver.

UNIFORM!
They Stand **Up**

No matter whether you buy a TOBE Condenser in California or New York, whether you buy it this year or next year, the quality will be the same. *All* TOBE Condensers are made of materials selected for their serviceable and *lasting* qualities, by methods perfected over years of experience. *All* TOBE Condensers are made to work continuously at their rated voltages — *and do.* The trademark "TOBE" takes all the doubt out of condenser performance. For sale wherever Good Radio is Sold.

Write us for pamphlet L-12

Tobe Deutschmann Company
Cambridge ·:· *Mass.*

MR. RADIO EMPLOYER!

Do You Need Some Good Men?

Radio employers who wish to make additions or replacements within their organizations should call on our Free Employment Service for assistance. Men usually available at any point in the United States or Canada on 48 hours' notice. There is absolutely no charge for this service, either to the employer or to the employee.

We can supply men qualified for work in manufacturing plants, research and designing laboratories, or broadcast stations; licensed men for commercial land and sea operating jobs; Radio-trained salesmen for the manufacturer, jobber, or retailer; men who are competent at Radio service, installation, construction, and repair.

If you need a trained Radio man for any kind of work, or if you expect to need one in the near future, see if we can't help you. Write, describing the position and the sort of man you desire. You'll be informed promptly if we have the man you need available. Address correspondence to M. B. Taylor, Manager, Employment Department, National Radio Institute, Washington, D. C. A free monthly bulletin, listing men available and their qualifications, is published by this department. Your request will bring it to you regularly. Please refer to "RADIO."

(We conduct the oldest and largest Radio home-study school in the world, and our students and graduates are to be found in almost every Radio organization of importance. Our course of practical training is recognized by the U. S. Government, which allows our graduates the customary points of credit toward any Radio license they may wish to take out. See announcement on opposite page.)

Want More Money?

You Can Increase Your Earning Power By Learning More About Radio

If you're making a penny less than $50 a week, you're not getting what you ought to get out of Radio.

Thoroughly trained men—men whose knowledge of Radio is completely rounded out on every point—earn all the way up to $250 a week.

Radio is a new industry with plenty of fine positions unfilled. There are countless opportunities in Radio for a man to earn a splendid salary. But these are not opportunities as far as you are concerned, unless you're fully qualified for them.

The only way to qualify is through knowledge — training — *practical,* complete training, that fits you to get and to hold a better position in the Radio field.

See If This Free Book Can Do You Any Good

I publish a 64-page book, printed in two colors and filled with facts and photos relative to Radio and its opportunities.

I don't say this book will help you, but it *does help* such a large percentage of those who read it that I can afford to send it to all who ask for it—free. You may get only a single idea out of this book that will be of any value to you. Or every line of it may give you a message.

At any rate, fill in the coupon below and look it over. It costs you nothing but a two-cent stamp, and you place yourself under no obligation. I won't even send a salesman to call on you. And there's always a chance that that two-cent stamp may make quite a difference in your future.

A message to men now in the Radio business. And another to men who would like to be in.

I have helped all sorts of men to advance themselves in Radio.

Lots of them, men who knew absolutely nothing about Radio when they first wrote me. Some who didn't know the difference between an ampere and a battle axe.

Others, graduate electrical engineers who wanted special work in Radio. Licensed sea operators who were way behind on the "BCL stuff." "Hams" by the score.

Last, but not least, the service and repairman or salesman who wanted to advance or go into the Radio business on his own. And the man already in on his own, who wanted to look forward to a more solid and permanent Radio future.

My Free Book—see coupon below—tells about my helpful methods, and cites the experiences of a hundred men—giving photos and addresses.

What My Radio Training Is

Under my practical system, a man can study at home in his spare minutes and get a thorough, clear, practical and expert knowledge of Radio in from 4 to 12 months. The time required depends on his previous knowledge, his ability, and the time he can spare for study. He keeps right on with the job he has—no necessity for his leaving home or living on expense.

Then, as soon as he's ready for a better position, I'll help him to get it and to make a success of his work. (See announcement on opposite page.)

This proposition is open to anybody who is not satisfied with his job, his prospects, or his Radio knowledge. Regardless of how much you know already (or if you don't know the first thing about Radio technically), I'll fit my methods to suit your needs.

If you want to enter into any correspondence about your own situation, anything you write will come directly to me and will be held strictly confidential.

Tear the coupon off now before you turn the page and mail it to-day.

J. E. Smith, President

National Radio Institute

Washington, D. C.

Oldest and Largest
Radio Home-Study
School in the World

Originators of
Radio Home-Study
Training

J. E. Smith, President,
National Radio Institute,
Department P-86, Washington, D. C.

Please send me your free book about the bigger opportunities awaiting the thoroughly trained Radio man. At present I (am) (am not) in the Radio business.

Name..

Address...

Town.......................................State.......................................

New Aero Kits Used In Important Circuits

The Improved Aero-Dyne 6, the Aero 7 and Aero 4—all popular new circuits—are built around these marvelous coils

You Should Learn About Them *Now!*

**AERO UNIVERSAL
TUNED RADIO FREQUENCY KIT**

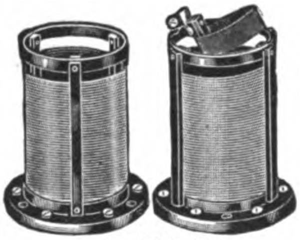
Especially designed for the Improved Aero-Dyne 6. Kit consists of 4 twice-matched units. Adaptable to 201-A, 199, 112, and the new 240 and A. C. Tubes. Tuning range below 200 to above 650 meters.
This kit will make any circuit better in selectivity, tone and range. Will eliminate losses and give the greatest receiving efficiency.

Code No. U-16 (for .0005 Cond.)...... $15.00
Code No. U-163 (for .00035 Cond.).... $15.00

**AERO SEVEN
TUNED RADIO FREQUENCY KIT**

Especially designed for the Aero 7. Kit consists of 3 twice-matched units. Coils are wound on Bakelite skeleton forms, assuring a 95% air dielectric. Tuning range from below 200 to above 550 meters. Adaptable to 201-A, 199, 112, and the new 240 and A. C. Tubes.

Code No. U-12 (for .0005 Cond.)...... $12.00
Code No. U-123 (for .00035 Cond.)..... $12.00



AERO FOUR KIT

An exceptionally efficient kit for use in the Aero 4 and other similar circuits. Consists of one Aero Universal Radio Frequency Transformer and one Aero Universal 3-Circuit Tuner. Uses 201-A, 112, 199 and new A. C. Tubes.

Code No. U-95 (for .0005 Cond.)....... $8.00
Code No. U-953 (for .00035 Cond.)..... $8.00

NOTE: *All AERO Universal Kits for use in tuned radio frequency circuits have packed in each coil* with a fixed primary, *a twice matched calibration slip showing the reading of each fixed primary AERO Universal Coil at 250 and 500 meters; all having an accurate and similar calibration. Be sure to keep these slips. They're valuable if you decide to add another R.F. Stage to your set.*

A NEW SERVICE

We have arranged to furnish the home set builder with complete Foundation Units for the above named Circuits and for the Chicago Daily News 4-Tube Receiver and the Aero Transmitter Set, drilled and engraved on Westinghouse Micarta. Detailed blueprints and wiring diagram for each circuit included with every foundation unit free. Write for information and prices.

You should be able to get any of the above Aero Coils and parts from your dealer. If he should be out of stock order direct from the factory.

AERO PRODUCTS, INC.
Dept. 104
1772 Wilson Ave., Chicago, Ill.

Your Laboratory Tools

(*Continued from page 447*)

placed near the grinding wheel should be used in cooling off the tool while sharpening it.

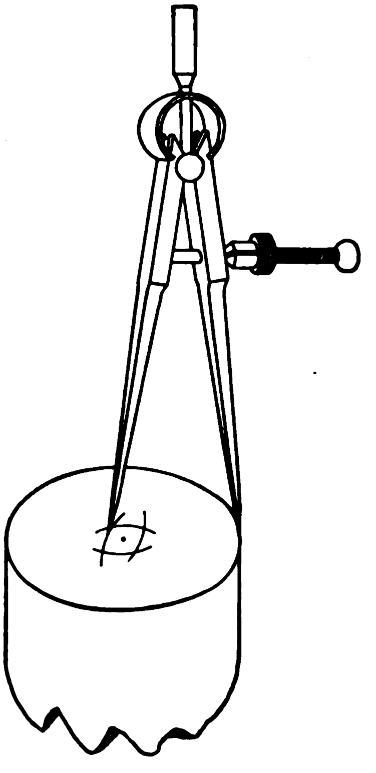
Figure 8 will help the reader to master the trick of grinding tools. "A" shows a very bad example; a tool ground in this way would last but a few seconds before the cutting point broke off. It could not fail to break off, as there is no support under it. "B" is an example of the opposite extreme. Here the non-cutting portion of the tool projects out so far that the real cutting edge at the top of the tool cannot be brought in contact with the work. If the reader buys a set of lathe tools already sharpened he will do well to maintain the original shape in resharpening them.

There is also what is known as "negative" and "positive" rake in cutting tools; examples of these are shown at C and D, Figure 8. Tools with positive rake cut more easily than tools with a negative rake. As a matter of fact, they cut too easily when used with soft metals such as brass and cast-iron. A tool with a positive rake has a tendency to bite into soft metal. The tendency to do this is so great at times as to make the tool actually jam and stall the lathe. A tool with a negative rake (example seen illustrated at D) may be used with safety on both brass and cast-iron.

To cut properly, a tool must be mounted in the tool post so that it comes in contact with the work just a tiny fraction of an inch below the center. We see this illustrated in Figure 10.

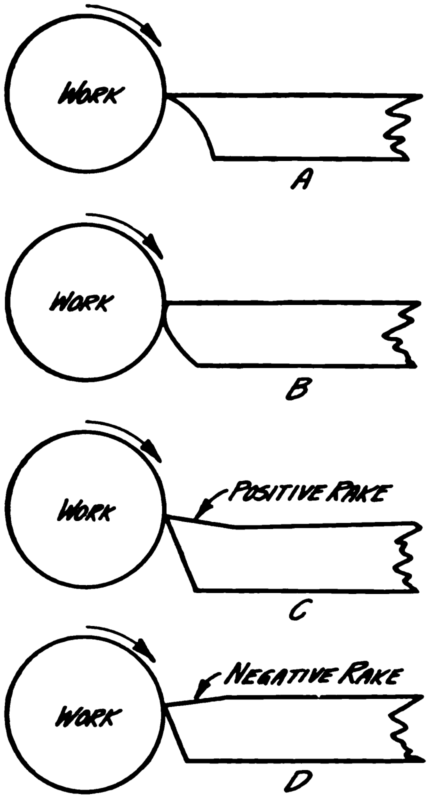
The experienced mechanic will usually succeed in mounting the tool properly, but the beginner must learn by experience, and if the tool does not cut fast and clean, he should have the patience to re-adjust it until he succeeds in obtaining the proper cut.

The manipulation of the feed handles of the slide rest is a thing that cannot be lectured upon with much success; only experience will give the operator expertness and confidence. One great mistake made by beginners is that of attempting to take too large cuts. This not only dulls the lathe tool, but it is an actual strain upon it and upon the bearing of the lathe, to say nothing of the possibility of overheating the driving motor. It must be remembered that a lathe tool is extremely hard and very brittle. Consequently, there is a limit to the strain that it will withstand. When steel is being turned it is good practice to mount the tool so that the cutting edge does not project too far out of the tool post. This reduces the leverage and consequently the possibility of breakage. A few drops of oil put on the end of the cutting tool will not come amiss when working with steel.



FINDING THE CENTER

FIGURE 7: *Here is a simple way of locating an approximate center on work that is to be mounted in the lathe. For all ordinary purposes this is sufficiently accurate.*



RIGHT AND WRONG

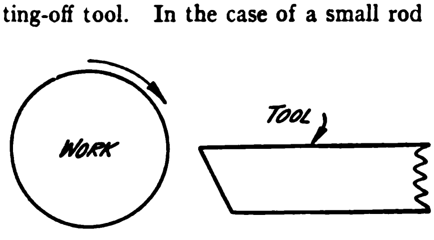
FIGURE 8: *At "A" and "B" two improperly ground tools are illustrated, while at "C" and "D" there is illustrated the difference between the positive and negative rake.*

Figure 2 illustrates at close range the scroll chuck that was mentioned in the second article of this series. When small pieces of metal are to be turned the centers of the lathe need not be pressed into service. There are but two factors that determine whether or not it is possible to turn down a metal rod with the aid of the scroll chuck. One of these factors is the diameter of the rod and the second factor is the distance that the rod will protrude out of the chuck. It is obvious that we could not hope to turn down the end of a small rod that protrudes very far beyond the chuck jaws. If such a job should be attempted, it would be found that the rod would spring when the lathe tool was brought in contact with it.

Naturally, this chuck will not accommodate a wide variety of shapes. It will hold round and hexagon rods very nicely, but different arrangements must be provided for odd shapes. The knurled ring shown at C in Figure 2 is used to tighten or loosen the jaws A. The inside jaws are illustrated in position while the outside jaws—that is, the jaws that are intended to grip the outside of the work—are illustrated at B. Naturally, if the operator finds that the capacity of the chuck when used with the inside jaws is not great enough to accommodate a piece of work, the outside jaws are put in place, each jaw always in its proper position. To make the correct placing of the jaws sure it will be found that the slots on the jaw and the jaw proper bear corresponding numbers.

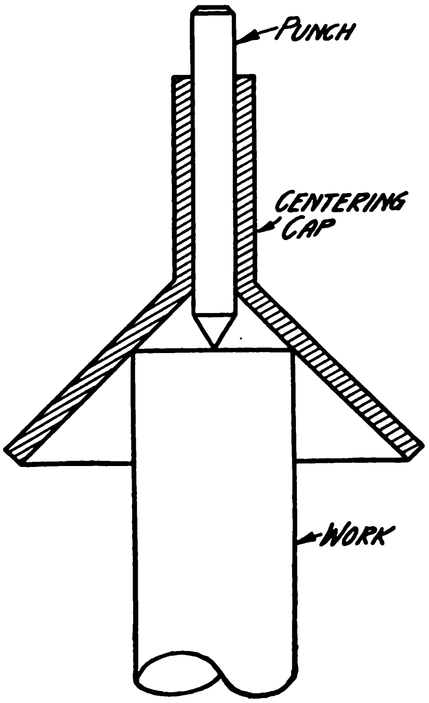
The use of the chuck in turning down the inside of a brass tube or collar is illustrated at Figure 4. The work is indicated at A and the cutting tool at B. The student of this series of articles will do well to study the position of the cutting tool. It is what is called an inside cutting tool and used only for work of this nature.

The use of the compression chuck is illustrated at Figure 5. This figure illustrates what is called a cutting-off operation and a cutting-off tool is shown mounted in the tool post. A is the chuck, B is the work and C is the cutting-off tool. In the case of a small rod projecting the same distance illustrated it would be impractical to attempt to turn the end, owing to the possibility of springing.



HOW THE CUTTING TOOL IS MOUNTED

FIGURE 10: *The cutting tool is brought to a position so that its cutting edge is just slightly below the center of the work.*



ANOTHER WAY OF FINDING THE CENTER

FIGURE 9: *Here a "bell center" punch is used for finding the center of work to be mounted in the lathe. This is a quick and fairly accurate method.*

This compression chuck is extremely useful and convenient when a large number of pieces are to be cut from the long rod. In such work the rod may be fed through the hollow spindle of the lathe into the chuck and after each cutting-off operation it is only necessary to loosen the chuck and shove the rod through until the proper amount is again projecting.

In turning down work on a lathe, the question of proper speed is important. Experience has shown that soft metal can be cut best at high speed, while steel or any metal that offers severe resistance to the action of a cutting tool requires low speed. Consequently, when brass, soft iron or aluminum is being turned, the belt should be riding on the smallest of the three pulleys. When steel or an equally tough metal is being cut, the belt should be riding on the largest pulley.

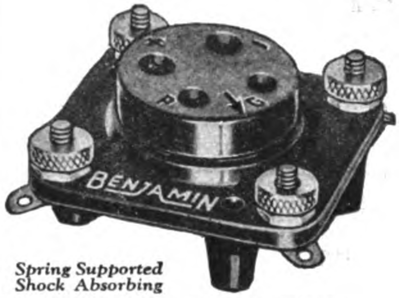
Mechanics must always remember that the lower the speed the greater the amount of power delivered to the work. Reducing the speed for steel is simply a matter of providing the work with sufficient torque or turning power to overcome the resistance offered the cutter.

In the next installment of this series Mr. Madden will tell mechanically inclined thinkers how they may use a lathe for a wide variety of odd jobs—jobs that are ordinarily considered outside the range of this important tool. Special emphasis will be laid upon the application of the lathe in doing many of those jobs that cause radio fans so much trouble.

BENJAMIN
TRADE MARK

Red Top

Cle-Ra-Tone Sockets



Spring Supported Shock Absorbing

Makes the socket stand out from the dead black of the base and panel

Easier to establish correct position of tube and prongs

Improves the appearance of the set

Have all spring supported and shock absorbing features of the famous Cle-Ra-Tone Sockets. Non-microphonic. Unaffected by stiff bus wiring. Tube holding element "floats" on four finely tempered springs.

Used in most of the leading circuits. Among the most recent for which Cle-Ra-Tone Sockets have been specified are:

Strobodyne 8
Magnaformer 9-8
Camfield Super-Selective 9
Lynch Suppressor Circuit
H. F. L. Nine in Line
World's Record Super 10
Melo-Heald Fourteen
St. James Super
Karas Two-Dial Equamatic
Knickerbocker 4
Hilograd Receiver
International One-Spot
Thompson Super 7
Hot Spot Fourteen

PRICES

Push Type, on Mounting Base

Benjamin Cle-Ra-Tone Sockets........ 75c each
Without Mounting Base............. 50c each

Green Top Sockets for A. C. Tubes

Specially designed, for use with 5-pronged A. C. Radio Detector Tubes:

For direct attachment to panel........ 90c each
For mounting on top of panel....... $1.20 each

Insist on the socket used by those who know and want the best. ASK FOR BENJAMIN "RED TOP," or "GREEN TOP."

At all Radio Jobbers and Dealers

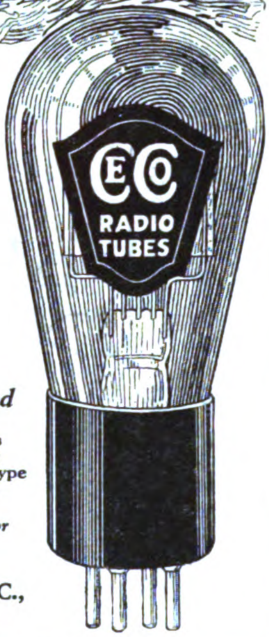
Made by

Benjamin Electric Mfg. Co.
120-128 So. Sangamon St., Chicago

247 W. 17th St.
New York

448 Bryant St.
San Francisco

Manufactured in Canada by the Benjamin Electric Mfg. Co., Canada, Ltd., Toronto, Ontario



IN THIS ISSUE
CECO TUBES ARE
SPECIFIED FOR THE
LYNCH "FIVE" and
FOR REMODELING THE
ATWATER KENT

Power

The modern battleship, typifying power, is a true symbol of the engineering genius, the mechanical and electrical precision embodied in Ceco Tubes.

Judge these triumphant Ceco Tubes by RESULTS achieved in your own set---Buy them by tbe *name* Ceco, choosing in consultion with your radio dealer the general or special purpose tubes best suited to your set.

You may justly expect more of Ceco Tubes and you'll GET more.

Steadier Performance---Longer Life.

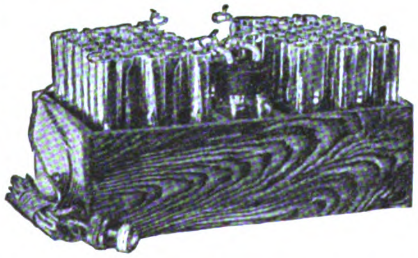
CECO RADIO TUBES

A Type for Every Radio Need

General Purpose Tubes
Special Purpose Tubes
Power Tubes, Filament Type
Rectifiers, A. C. TUBES.

Ask your radio dealer for complete data sheet of Ceco Tubes

C. E. MFG. CO., INC.,
Providence, R. I.



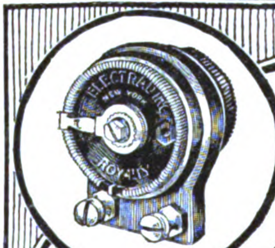
90 Volt Power Unit :: $12.75

Hums, line noises, etc., positively impossible with this new advanced unit. Plug in and forget. Non-acid and noiseless. All detector and intermediate voltages plainly marked. Simpler to hook up than dry cells. Operates any type set 1 to 12 tubes. Greater volume and clearness guaranteed. If not thoroughly satisfied, return after using 30 days for complete refund. Guaranteed further 2 years. For 110-120 volts AC 25 to 60-cycle current. 90 volts, $12.75; 112½, $15.25; 135, $17.50; 157½, $19.50; 180, $24.00; 202½, $26.00.

Also built for DC current, 110 and 32 volts, at only $3.00 additional, any size above. Ample stocks—same day shipments. Simply say—ship C.O.D. or write for my interesting literature, testimonials, etc.

B. HAWLEY SMITH

340 Washington Ave., Danbury, Conn., U. S. A.



Exclusively Licensed by Technidyne Corporation under U. S. Patent No. 1593658, July 27, 1926.

Accurate!

ELECTRAD
ROYALTY VARIABLE HIGH RESISTANCES

If you want a high resistance control of unusual accuracy—
And if you want it to be unfailingly dependable under all conditions—
Then you want Royalty Variable High Resistances. Note these exclusive features:

1—Resistance element not exposed to mechanical wear.
2—Contact made positive by metallic arm on wire wound strip.
3—One turn of knob covers whole range of resistance.

A range for every purpose, designated A to L. Type E $2.00. All other types $1.50.

Write for free hook-up circular

175 Varick Street Dept. 59C New York, N. Y.

ELECTRAD INC

1,000,000-Watt Broadcasting

(*Continued from page 412*)

1921, one-half kilowatt was standard; in 1924, 5 kilowatts came to be regarded as a reasonable power; to-day the 50-kilowatt station has its recognized place, and perhaps by 1930 the 500- to 1,000-kilowatt station will be regarded as normal.

People have occasionally gotten the impression that high-power stations were not capable of high tone quality of modulation. This is far from being the case, however. Actually the tone quality of the highest power stations in the United States is second to none, and there is no technical reason why it should be in anywise inferior to lower powered broadcasting.

If stations of a power of from 500 to 1,000 kilowatts come into moderately general use, their performance will depend upon certain factors. If fading is eliminated they will have a service range of from 300 to 500 miles, which will give truly admirable coverage and economic justification for such stations. If fading is not eliminated, the range will still remain restricted to 100 or 150 miles, but they will give a greatly enhanced quality of service in the outer portions of the service zone, as compared to the 50-kilowatt stations now used.

Another justification for the present trend toward higher transmitting powers is the inevitable presence of electrical disturbances in the neighborhood of human habitations. We cannot shut down every electric fan, every refrigerator, oil burner, motor, or other electrical device in the neighborhood. This might be too high a price to pay for a radio program, except perhaps to those of us who are members of a broadcasting association. As has been clearly pointed out by the National Electric Light Association recently, one of the desirable ways of meeting the problem of electrical disturbances of radio reception is by increasing the power of broadcasting stations.

We are now entering an era of real broadcasting service of a reliable nature. This is not an easy thing to accomplish in a country like the United States, where vast areas have to be covered. It is also difficult to work out any orderly plan with 700 stations in the field. We may congratulate ourselves that the number of stations is not 7,000, and we may perhaps consider how much luckier it would be if the number of stations were 70.

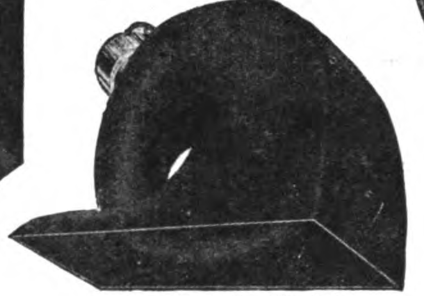
Archimedes once said: "Give me a fixed point for my lever and I will move the earth." And so, we may say of our newer field of broadcasting: "Give broadcasting the necessary transmitting power to reach all listeners clearly and it will move the souls of men."

RACON EXPONENTIAL SOUND CHAMBERS

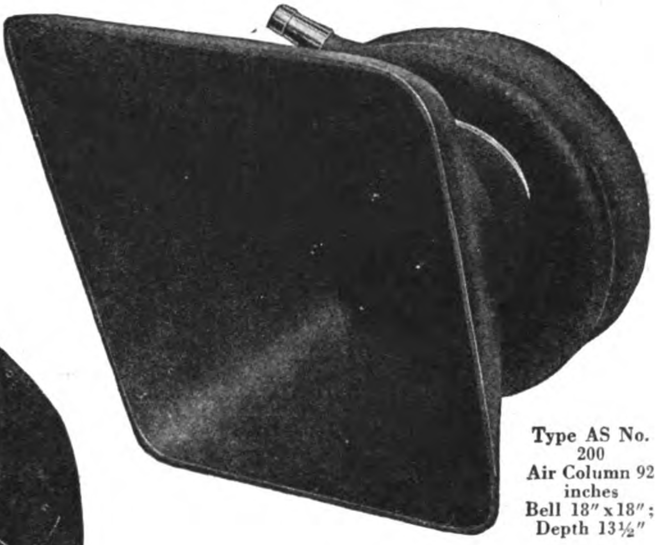
Known the World Over for Their Superiority

Racon Horns insure quality of performance much more naturally than that obtained by any other mode of amplification because of the true scientific principles of design and the exclusive material employed. Every Racon horn conforms to the latest theory of exponential design.

Type OB No. 1315
Air Column 104 inches
Bell 18″ x 24″; depth 13″



Type OB No. 320
Air Column 78 inches
Bell 10″ x 20″; Depth 13½″



Type AS No. 200
Air Column 92 inches
Bell 18″x18″; Depth 13½″

The RACON Process assures uniformity; strength; maximum quality; minimum weight.

RACON Horns are made of impregnated cloth under our own patents No. 1,507,711 and No. 1,501,032.

For further details address

RACON ELECTRIC COMPANY, Inc.

18-24 Washington Pl. **New York, N. Y.**

Simplified Blue Prints

of the

"Town and Country"

Portable Receiver

The "Town and Country" Portable Receiver, developed by the POPULAR RADIO LABORATORY and described in a former issue, marks a decided advance in portable receiver design. While not a "vest pocket" receiver, the new "Town and Country" is small enough to be taken along on a motor boat or train trip. Efficiency has not been sacrificed for the sake of compactness.

The receiver uses six UX-199 tubes and one UX-120 power tube. Operating on a loop, tone quality is guaranteed by the use of a fundamentally correct circuit, high-class transformers and cone-type speaker.

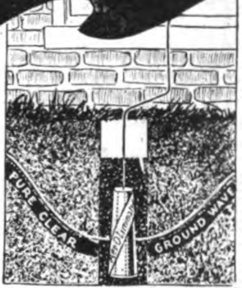
The "Town and Country" Portable Receiver is mounted in a special mahogany cabinet with a drop front and is equipped with a carrying handle. All equipment, including the folding loop, cone loudspeaker, batteries and connecting cable, is installed in a suitcase. Connections from the equipment to the set are made by means of jacks and plugs.

By using POPULAR RADIO Blue Prints in building your "Town and Country" receiver, you can save time, eliminate the possibility of error, and make your set exactly like the laboratory models.

If your local dealer cannot supply you with Blue Prints of this set, they will be sent post paid upon receipt of $1.00 per set.

POPULAR RADIO
Service Bureau 24-D
119 W. 57th St., New York City

Amazing New Ground Antenna



Gets Far-away Stations Loud and Clear Regardless of Static Conditions

Radio Engineers and hundreds of users report that Aer-O-Liminator, the sensational new *Ground Antenna,* gets better long distance reception, almost unbelievable freedom from static and outside noises, far greater selectivity and marvelously clear and sweet tone quality.

Says "Cuts Out Static"

R. Curtis of Ill., says, "There's no such thing as static trouble since I got my Aer-O-Liminator. I get stations I never got before—so loud and clear I would almost swear they were in the next room." In addition you are free from troublesome overhead aerials that everyone now knows are static-gatherers. Aer-O-Liminator (Ground Antenna) is simple and easy to install. Takes but a few minutes.

FREE TRIAL

MAKE THIS THRILLING TEST AT OUR RISK!

Install an Aer-O-Liminator (Ground Antenna). Leave your old overhead aerial up. Try out on a night when static is bad. If you do not get a wonderful improvement in freedom from static, greater selectivity and clear, sweet tone without interfering noises, if you can't get good reception on stations that are drowned by static on your old aerial, you need not pay us a red cent for this test. Send coupon today for scientific explanation of Aer-O-Liminator (Ground Antenna), proof of performance, and our conclusive iron bound guarantee and remarkable Free Trial offer. Send coupon today!

CURTAN MFG. CO.
154 E. Erie St. **Dept. 806-T**
Chicago, Ill.

Rush This Important Coupon

Curtan Mfg. Co.,
154 E. Erie St., Dept. 806T,
Chicago, Ill.

Please send me at once complete description of Aer-O-Liminator with details of guarantee, Scientific Proof and FREE TRIAL OFFER.

Name...
Address...
City...
State...

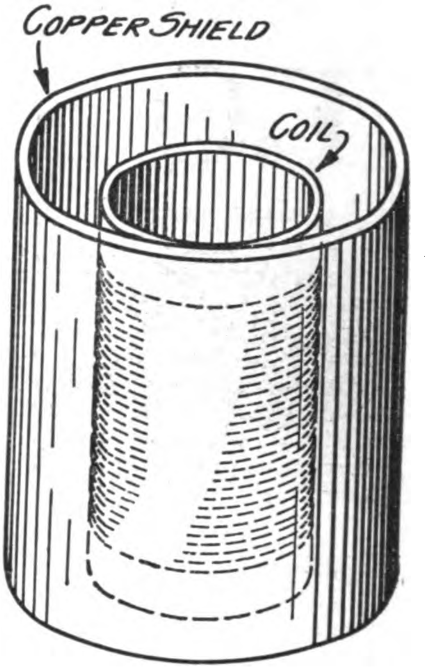
Children are the parents of tomorrow. Help guard their health.

Buy Christmas Seals

THE NATIONAL, STATE, AND LOCAL TUBERCULOSIS ASSOCIATIONS OF THE UNITED STATES

The Harkness Counterfonic

(Continued from page 433)



A NOVEL SHIELDING METHOD

FIGURE 4: *The Counterfonic coils are placed concentrically within open-ended cylinders of heavy copper, giving an adequate shielding effect without changing the characteristics of the coil to any great extent. If the shields were closed at the ends, the electrical constants of the coil might be seriously affected.*

will give him an unexcelled quality of reproduction.

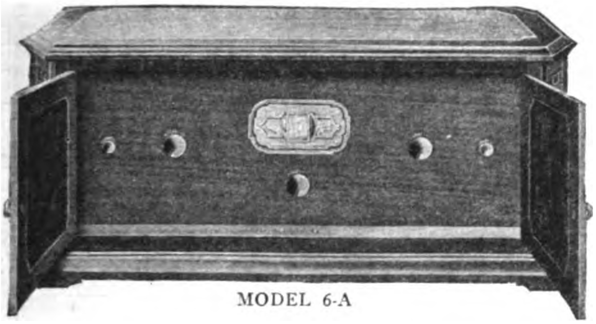
In the January number of POPULAR RADIO the full constructional details for the receiver will appear in an article written by Kenneth Harkness himself.

Below is a list of parts for the new receiver.

LIST OF PARTS FOR
The Counterfonic Six
TO BE FEATURED IN THE JANUARY NUMBER OF POPULAR RADIO—

3 Harkness Counterfonic RF transformers;
3 Copper shields;
1 Westinghouse Micarta front panel, completely drilled;
1 Westinghouse Micarta sub-panel, completely drilled, with 6 vacuum valve sockets attached;
3 Harkness tuned double-impedance couplers for the first, second and third stages;
1 Harkness output filter unit;
1 Harkness RF choke coil;
1 U. S. L. 3-gang variable condenser, .00035 mfd.;
1 S-M drum dial;
1 Carter midget rheostat, 10 ohms;
2 Saturn battery switches;
1 Carter fixed filament resistor, 4/5 ohm;
3 Aerovox fixed condensers, .0001, .00025 and .001 mfd.;
1 Lynch grid-leak, 2 megohms;
2 X-L neutralizing condensers, .0001 mfd.;
12 Eby binding posts;
3 Hammarlund equalizing condensers;
1 Aerovox by-pass condenser, 1 mfd.;
1 Pair of Harkness brackets, 9½ inches long.

What
TONE!



MODEL 6-A

BROWNING-DRAKE tone perfection has long been an appreciated fact. So faithfully do the new Browning-Drake Receivers reproduce every sound sent into the microphone that the broadcasting artists seem to be in the very room with you. From the lowest tone to the highest, Browning-Drake reproduction is clear, undistorted . . . REAL!

The new model 6-A has six tubes. Four audio tubes give fine tone and ample volume. Single dial illuminated drum control simplifies tuning. Exceptional selectivity makes it easy to tune out interfering stations. Complete shielding prevents interference. Auxiliary condenser brings signals of distant stations to maximum intensity. Beautiful two tone Duco walnut cabinet harmonizes with all home furnishings. Length, 27 inches; depth, 15 inches; height, 11 inches. Price without tubes and batteries, $105. Other models at $95 and $145.

DEALERS: Write TODAY for information on the Browning-Drake line of factory-built receivers and the Browning-Drake Corporation Kit and line of parts.

BROWNING-DRAKE CORP.
CAMBRIDGE : : MASS.

BROWNING-DRAKE
CABINETS PARTS **RADIO** **RECEIVERS KITS**

YOU
MAY NOW
HAVE THE
REALISM OF
RADIO FROM
YOUR OLD
PHONOGRAPH
BY USING THE
NEW RECORDS
AND STANDARD
RADIO AMPLIFYING
EQUIPMENT

SEE THIS AND
FORTHCOMING ISSUES OF
POPULAR RADIO

$2

NA-ALD
MIDGET
CONE SPEAKER
NO. 5041

"The Wee Sma' Speaker for the Wee Sma' 'oors!"

THE MINIATURE CONE SPEAKER of big results. Only 5 inches in height, with adjustment screw and all the characteristics of large cone speakers, but volume in proportion to size. Just the thing for use late at night, when the family is abed. Beautifully made of Genuine Parchment, finished in Japanese Wood Gray, standard and fine speaking unit. Only $2.00; by mail direct, if your dealer cannot supply. Everyone will have one of these miniature speakers. Ideal for bridge or other prizes. Enjoy one today!

USUAL TRADE DISCOUNTS TO DEALERS

ALDEN MANUFACTURING CO.
SPRINGFIELD, MASSACHUSETTS

Townsend
"B" Socket Power
"Best in World!"
Says A. W. GALE
of Gloversville, N. Y.

Only $6.85 COMPLETE
$1.00 Down
Balance C.O.D.

Below is a reproduction of Mr. Gale's letter of May 8th, 1927.

48 W. Fulton St.,
Gloversville, N. Y.

"Received the Townsend all O. K. *It is the best in the World and that is saying some.* I have a Radiola 4 tube. Get more stations than ever before. Some of them are CFCF, CKNC, WGY, KDKA, WGZ, WIP, WWJ, KTHS, KOP, KOA, WHAS, WTAM and KSD—besides 4 in Chicago, all in the East and then some."

A. W. Gale.

Replaces "B" Batteries

The letter above speaks for itself—proves beyond doubt that the Townsend "B" Socket Power is the most remarkable value in Radio today. Sam E. Fry of 1415 Holmes St., Kansas City, Mo., writes: "Eliminator works fine. Showed it to a friend and he wants one also. I will say it sure beats batteries. I get stations I never got before on a 6 tube set." Charles Ellis, 88 Jones Ave., Columbus, Ohio, says, "Your Eliminator is working fine. Have had station WJAX and others over 1,000 miles distant. Picked up 22 different stations one evening and around 30 another time. My neighbor has a $27.50 Eliminator and I don't see that it works any better than yours."

Delivers up to 100 volts on any set, on D. C. or A. C.—any cycle. Full tone, clarity and volume.

Tested and approved by America's leading Radio authorities—Radio News and Popular Radio Laboratories

ORDER TODAY!

Simply fill out the coupon and slip it into an envelope with only $1.00 and mail at once. Your Townsend "B" Socket Power Unit will be sent promptly. Deposit only $5.85 plus postage with the postman. Try out for 10 days—then if not delighted with improvement in reception, return it to us and purchase price will be refunded.

TOWNSEND LABORATORIES
713 Townsend St., Dept. 19, Chicago, Ill.

Attach Only $1.00 to this Coupon!
SEND TODAY

10 Days FREE TRIAL You are the Judge!

TOWNSEND LABORATORIES
713 Townsend St.
Dept. 19, Chicago, Ill.

Gentlemen: Attached find $1.00. Kindly send at once Townsend "B" Socket Power Unit, C. O. D., for $5.85, plus postage, on guaranteed 10-day free trial.

Name......................................

Address......................................

City..........................*State*..............

IN THE WORLD'S LABORATORIES

CONDUCTED BY DR. E. E. FREE

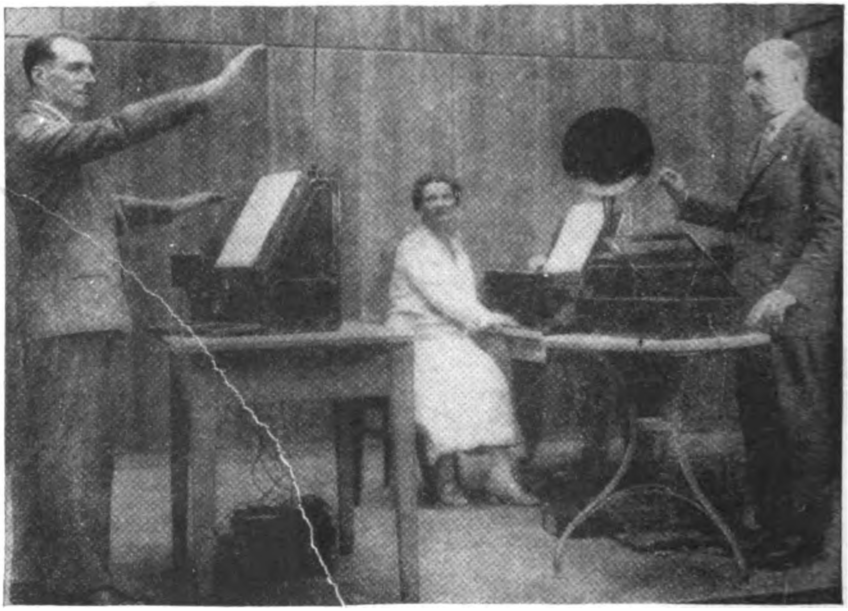
Radio Music By Hand

GERMAN musical circles have been somewhat excited this summer by a young Russian professor, Leo Theremin, of Leningrad, who waves his hands in the air above a box full of radio apparatus and proceeds to play tunes thereby. Were this the fifteenth century instead of the twentieth, Professor Theremin would probably have disappeared by now into the hands of the torturers appointed to deal with witchcraft. As it is, the torture is the lot of his hearers, if perchance his hand happens to slip.

German accounts of the innovation have not been especially lucid and Professor Theremin himself does not seem to have described in accessible publications the details of his method. Fortunately, Mr. Waldemar Kaempffert, the able scientific adviser of the New York *Times,* visited Professor Theremin's demonstration in Berlin and reports the details in the issue of the *Times* for October 2, 1927. The secret, Mr. Kaempffert discloses, is merely a controlled use of well-known body-capacity effects.

Professor Theremin's apparatus contains two radio oscillators, one of which can be varied in frequency by approaching or withdrawing the hand. The note produced by the apparatus is, of course, the heterodyne note of these two oscillators. By waving his hand in just the right fashion and at just the right distance from the projecting portion of his sensitive circuit, Professor Theremin can alter the frequency of this heterodyne note, causing it to take any desired frequency in the musical scale.

By means of another projection of the circuits, operated by his other hand, Professor Theremin can use similar body-capacity effects in order to alter the amplitude of the heterodyne im-



Underwood & Underwood

PLAYING THE HETERODYNE ORCHESTRA

Professor Leo Theremin, the young Russian radio expert who extracts music from radio circuits operated by body capacity effects, is at the reader's left, waving his hands near the two control antennas which alter the frequency and amplitude of the two internal oscillators. The heterodyne note of these oscillators provides a musical tone which can be varied at will, the music emerging from the loudspeaker on top of the accompanist's piano.

pulse and thus the loudness of the note. It is necessary, one imagines, to be rather competent and precise in the business of hand waving, but the skill required is presumably not much greater than that necessary to play other kinds of musical instruments.

Radio engineers have long been aware that musical tones of exceptional purity and wide variation of quality can be produced by means of vacuum valve circuits. The problem of arranging such circuits for actual musical use is one of ease of control, not of fundamental electrical principles. Whether Professor Theremin's device will prove to have solved this control problem sufficiently for practical musical use is perhaps a question, but if he has not done so presumably some one will. It is a safe prediction that music from tuned vacuum valve circuits will some day be an actuality.

An Acoustic Filter For Morse Code

A device both novel and ingenious for receiving dot-and-dash code in the midst of the most active interference was described last spring before the Radio Society of Great Britain by Mr. G. G. Blake, who has since printed a description of his apparatus in the *Wireless World*.* The essential idea is to select the signal note by acoustic resonance and to amplify it, allowing the miscellaneous sounds of the interference to disappear.

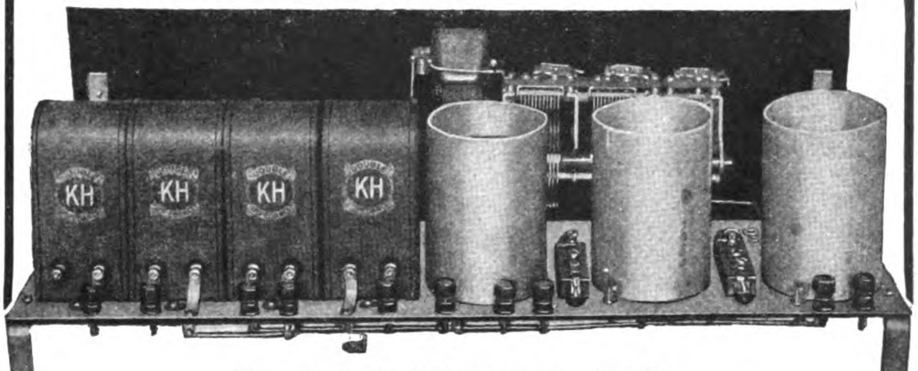
Every student of high school physics is familiar with the fact that hollow tubes or cylinders will respond by resonance to some particular tone, this tone being determined by the dimensions of the cylinder. By using a relatively long tube equipped with a plunger, it is possible to adjust this resonant tone over a somewhat wide range of musical frequencies. This is, of course, the familiar principle of the small tin whistles equipped with pistons, and of the slide trombone. Mr. Blake allows the output of his loudspeaker unit, containing not only his desired signal, but all the interference, to enter such a resonating tube. The resonator is then tuned, by sliding its piston in or out, until it reaches the frequency of the note which it is desired to receive. This note is then amplified automatically by the resonance.

At the end of the resonator, where it will be exposed to the air vibrations set up by the resonant note, Mr. Blake places a hot-wire microphone, substantially of standard type. This microphone picks up the tone given out by the resonator, converting this into an electric oscillation in quite the usual fashion. An amplifier of known character then strengthens this electric

---

*"Selective Morse Recorder," by G. G. Blake. The *Wireless World* (London), pages 213-215 (August 17, 1927) and 251-253 (August 24, 1927).

Complete Kit of Parts for the New
HARKNESS
Counterfonic Six
-the set with *tuned audio amplification*



Licensed under U. S. Patents issued and pending.

Makes Tone Perfection a Thrilling Reality!

The new Harkness Counterfonic Six reproduces voice and music with a degree of perfection never before attained in radio reception. By means of a patented method of "double impedance" coupling the audio amplifier can handle *four times as much volume* as any other type of amplifier, without overloading, tube blocking or distortion of any kind. Moreover, the audio amplifier is *tuned* to emphasize the amplification of low tones and thereby offsets the poor response of loudspeakers at low frequencies. The result—uniform *sound output* over the entire audible range, from 40 to 10,000 cycles.

The Counterfonic is tuned by a single knob. Each of the two stages of radio frequency amplification is neutralized and copper-shielded. The set is sharply selective and is a real distance-getter. Any B-eliminator can be used without "motorboating."

With the complete kit of parts, illustrated below, you can easily build the Counterfonic in less than three hours. The kit contains everything needed to build the set, exactly as specified by Kenneth Harkness. The front and subpanels are drilled and engraved. The assembly and wiring are fully explained and clearly illustrated in the step-by-step instructions accompanying the kit. Order your kit now and build the greatest set Harkness has ever produced.

Tuned Audio Amplifier Parts

You can greatly improve the volume and tone fidelity of your present set by installing Harkness Tuned Audio Couplers in the audio stages. They connect like transformers. The output filter also improves tone and protects your loudspeaker.

HARKNESS Double Impedance Tuned Audio Couplers, Set of 3 units..............$16.50

HARKNESS Audio Output Filter Unit................ 4.50

Complete Kit of Parts for the New
HARKNESS
Counterfonic Six
-the set with tuned audio amplification
KH
KH
KH
KH

Complete Kit

$\$57^{50}$

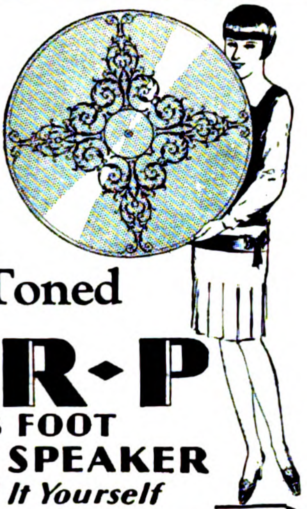
Includes all parts to build set

Free literature sent on request

Orders from Dealers and professional set-builders for above kit or audio amplifier parts filled at standard wholesale prices. Immediate delivery. Write for dealers' price list of complete line.

KENNETH HARKNESS, Inc.

SUITE 605-A, 72 CORTLANDT STREET, NEW YORK, N. Y.



Pure, Rich, Full-Toned

G·R·P
3 FOOT
CONE SPEAKER
Build It Yourself

"IT IS hard to believe that it is possible for a speaker to be better than yours," writes J. F. Welch of Cleveland, assistant editor of the Brotherhood of Locomotive Engineers Journal. "Its performance could not be fully described with superlatives. We shall be pleased to tell our readers that your speaker kit is unquestionably the best buy which we know of."

From G. R. P. 3-ft. Cone Speaker Kits you assemble a speaker equal to factory-built speakers costing 4 to 6 times as much. You get every note of every instrument in a complete symphony orchestra, through a G. R. P. 3-ft. Cone Speaker. You get it sweeter, clearer, purer, richer, fuller than you ever heard it before. Easy to assemble.

Ask your radio dealer for genuine G. R. P. 3-ft. Cone Speaker Kits—the sensation of radio. Refuse substitutes. If he won't supply you, send $13.50 for G. R. P. 3-ft. DOUBLE Cone Kit or $10.50 for G. R. P. 3-ft. SINGLE Cone Kit. Prices f.o.b., N. Y. C.

Write for "*How to Build 7 Practical 3-ft. Speakers*," sent for 10c coin or stamps.

G. R. P. PRODUCTS CO., Inc.
104 Fifth Avenue, *Suite 1997*, New York

XL Products

Pep up Your Set!

Tune quickly—adjust accurately—eliminate distracting noises—get correct tube oscillation—with X-L VARIO DENSERS in your circuit. Designers of all latest and best circuits specify and endorse.

MODEL "N"—Micrometer adjustment easily made, assures exact oscillation control in all tuned radio frequency circuits, Neutrodyne, Roberts 2-tube, Browning-Drake, Silver's Knockout. Capacity range, 1.8 to 20 Mfd. Price, **$1.00.**

MODEL "G"—Obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in superheterodyne and positive grid bias in all sets. Capacity range, Model G-1, .00002 to .0001 Mfd. Model G-5, .0001 to .0005 Mfd. Model G-10, .0003 to .001 Mfd. Price, each, with grid clips, **$1.50.**

X-L PUSH POST—Push it down with your thumb, insert wire, remove pressure, wire is firmly held. Vibrations will not loosen, releases instantly. A push post that excels in appearance, action, service and convenience. Price, each, **15c.**

PUSH POST PANEL—7 push posts mounted on black insulating panel with permanent white markings. Soldering lugs, raising bushings, screws for mounting, etc., in box complete. Price, **$1.50.**

Investigate the Goodwin Aperiodic Detector Circuit. This is applicable to any set and adds a stage without added tuning controls.

X-L Push Post

X-L Push Post Panel

FREE—New, up-to-date book of wiring diagrams showing use of X-L units in the new LOFTIN-WHITE constant coupled radio frequency circuit, and in other popular hook-ups. Send for yours today.

XL Radio Laboratories
2422 Lincoln Ave., Chicago, Ill.

Underwood & Underwood

DEMONSTRATING THE RADIO FRYING PAN

At the New York Radio World's Fair, Mr. Bernays Johnson, at the reader's left, showed that it is possible to fry eggs or boil water in a frying pan held close to the top of a cake of ice and unprovided with any visible fire. High-frequency electric waves emitted by an oscillator below the table-top are absorbed by the metal of the pan and provide the heat. Holding the frying pan is Fire Commissioner Dorman of New York City.

oscillation so that it will operate a relay and, in turn, a standard inker for noting the Morse signals on a tape. Mr. Blake reports that he can receive radio code quite legibly through interference which would ordinarily make the code signals totally inaudible.

English papers have reported Mr. Blake's device as promising the conquest of static in broadcasting. Obviously, this is not the case. The resonator can be adjusted to respond only to one tone at a time, a limitation which is desirable in receiving code sent by interrupted continuous wave, but which makes the reception of speech or music quite impossible.

A Wave of Quicksilver

ONE of the chief limitations that still remain on the practical use of electric current is the difficulty of converting alternating current cheaply and easily into direct current. A new and interesting type of rectifier for this purpose has been developed by Dr. J. Hartmann, of Copenhagen, Denmark, and was described by him before the recent meeting of the British Association for the Advancement of Science, in Leeds, England.* The effective part of this rectifier is a jet of liquid quicksilver.

Such a jet of mercury or any other conducting liquid, when projected into an alternating magnetic field, takes on a wavy shape, the exact shape depending upon the dimensions of the jet and the frequency of the field. Dr. Hartmann arranges such a jet inside a container provided, on its two sides, with contact plates against which the wavy jet can impinge. By properly adjusting the dimensions and placing of these contact plates, the jet may be made to be in contact with one plate during one-half of the current wave and in contact with the opposite plate during the reverse half. This provides a mechanism by which rectification can be produced without the use of moving parts, except the moving jet of mercury.

Practical utility will depend, one imagines, upon success in producing stable operation of the jet. Presumably

---

*Dr. Hartmann's paper is noted in *Nature* (London), volume 120, pages 416-417 (September 17, 1927).

this will not be without difficulty, but the success already attained implies that the difficulties permit of ultimate solution.

Tricks With Radio Power

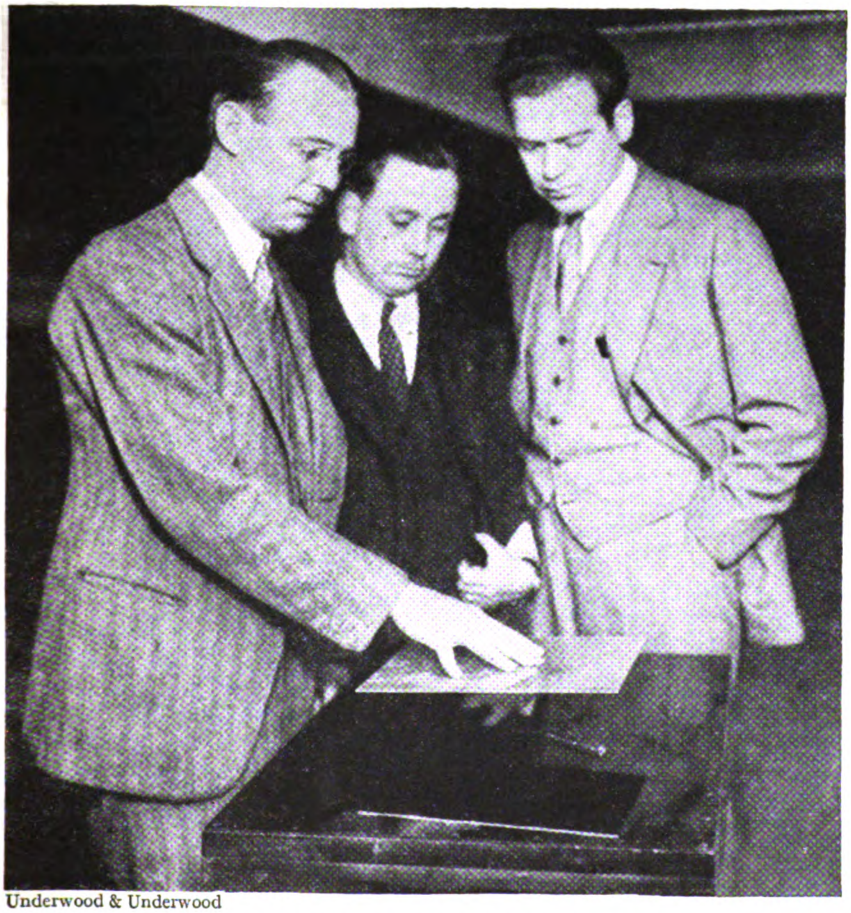
AT the recent Radio World's Fair in New York City, Mr. Bernays Johnson, already well known as one of radio's foremost masters of the spectacular, received a new title. By grace of newspaperdom, he is now "Radio Wizard." In the presence of admiring audiences, metal plates floated in the air at Mr. Johnson's behest. Water was boiled on top of a cake of ice and eggs were cooked in a similar situation. Lamps were lighted in empty air or when held in Mr. Johnson's hand, apparently unconnected with supplies of power. Even the end of an iron rod was melted electrically while the other end reposed, apparently not uncomfortably, between Mr. Johnson's lips.

To the experienced electrical experimenter these marvels are immediately obvious as due to the properties of high-frequency electric currents of the type made famous years ago by Mr. Nikola Tesla. The water boiled or the eggs cooked atop a cake of ice were heated, of course, by a metal plate, absorbing high-frequency electric radiation from an oscillator underneath the table. These waves traversed the ice-cake without great absorption and without heating it. The levitation of metal plates, perhaps the most startling of Mr. Johnson's tricks, is due to the generation in such plates of eddy currents opposed in phase to the arriving high-frequency radiation and thus repelled by it, as is required by the well-known theories of electromagnetism.

It is probable that the possibilities of these spectacular high-frequency waves for public amusement have by no means been exhausted. The suggestion is offered to radio fans possessed of a Tesla oscillator and a yearning toward vaudeville.

The Winds and Radio Time

MORE and more evident is the importance of radio in providing the world with that remarkable convenience called Standard Time. If President Coolidge summons his cabinet to meet at a designated hour or minute, it is



Underwood & Underwood

A MODERN MIRACLE OF LEVITATION

A metal plate that seems unaffected by gravity, flying upward at the word of command instead of falling to the earth, reproduces a marvel claimed by many self-styled magicians of antiquity, but realized only in these days of radio waves. The secret, as demonstrated by Mr. Bernays Johnson at the New York Radio World's Fair, is merely the producing of eddy currents inside the metal plate and the repulsion of these by the alternating field of a concealed oscillator circuit.

Volume Control
for any Circuit—

Centralab
Standard Radiohm

The exclusive Centralab feature of making contact on a resistance element by a pressure shoe and tilting disc, assures long life and permanently noiseless adjustment. Centralab Radiohms with 2 terminals and Modulators with 3 terminals, provide gradual, silent control of oscillation or volume.

Centralab Radiohms with resistance value of 2,000 ohms are used as stabilizing resistance in Reflex or Superheterodyne. Also used in the RF grid return circuits of tuned radio frequency sets. They provide excellent control of regeneration when shunted across the tickler in such circuits as Browning-Drake, Samson TC, Radio Broadcast, Aristocrat and others employing feedback principle. 25,000 ohms are especially adapted for the S-C circuits. 100,000, 200,000 and 500,000 ohms are the most satisfactory plate circuit resistance for controlling RF oscillation in tuned radio frequency circuits. Also, used to provide volume control.

There is a resistance and correct taper for every circuit, providing a perfect control of the circuit, with simplified panel appearance. Can be smoothly varied throughout their entire range from zero to maximum, and give full resistance variation with a single turn of the knob. Non-inductive; no sliding contacts carrying current. Exact resistance values are maintained as adjusted.

Resistances 2,000, 25,000, 50,000, 100,000 200,000 or 500,000 ohms, **$2.00**

Switch
Type
Radiohm

Same construction as Standard Radiohms and combine with the Radiohm a quick-acting "A" battery switch. This removes one more knob from the panel and makes the set simpler and easier to operate Provides two essential controls at little more than the price of one. Turning the knob to the right, lights the tubes and then increases volume. Turning the knob to the left decreases volume and then cuts off the battery. "A" battery switch parts are spring bronze, nickel plated with positive acting silver contacts.

200,000 ohms and 500,000 ohms, **$2.30**

Centralab
Modulator

The ideal panel-mounted volume control. Has 3 terminals and a special taper of resistance to provide smooth, noiseless volume control from a whisper to maximum. A sure cure for overloaded tubes and harsh amplifiers.

Resistances 250,000 or 500,000 ohms.... **$2.00**
500,000 ohms with "A" battery switch combined in one unit............... **$2.30**

At your dealer's, or C. O. D.

Central Radio Laboratories
17 Keefe Ave. Milwaukee, Wis.

Centralab

Your Neighbors Will Pay You $75.00 a week for Your Spare Time

You can easily sell them your spare hours for $3 each by serving as "radio doctor," building them sets, selling them supplies at less than retail. A membership in the Association shows you how to cash in on Radio now and trains you for the $3,000 to $10,000 openings awaiting qualified men. The Association starts you in business if you wish. Investigate all it has done for others, all it can do for you. A MEMBERSHIP NEED NOT COST YOU A CENT.

Earn $500 in Spare Hours

Our members are making big money with Radio. Werner Eichler, N. Y., earns $50 a week—Lyle Follick, Mich., has earned $500—F. J. Buckley, Mo.—makes as much as he receives from employer—all in spare time. Our members are starting radio stores, getting better positions, increasing their salaries, earning money spare time.

Act Now—for No-Cost Membership

Send post card for details of Special Membership Plan that need not—should not—cost you a cent, and our book, "Your Opportunity in the Radio Industry." It will show you how you can cash in on Radio now—and later.

Radio Association of America
Dept. PR-12, 4513 Ravenswood Ave., Chicago
Send me your book and details of your Special Membership Plan.

Name..
Address...
City..............................State............

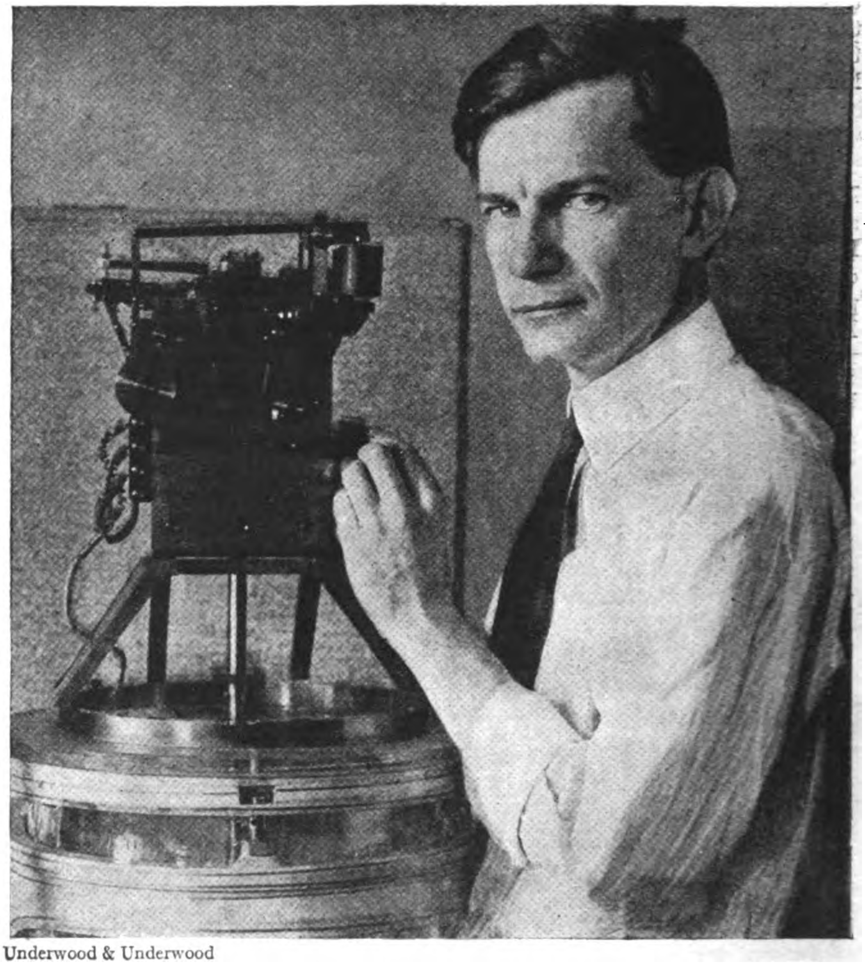
Write today
for your copy of

"Copper Shielding for Radio"

This new book shows how to improve the reception of your set. There is no charge.

Copper shielding means greater selectivity and sensitivity.

COPPER & BRASS
RESEARCH ASSOCIATION
25 Broadway, New York



Underwood & Underwood

TWO DICTATORS OF RADIO TIME

Mr. Paul Sollenberger, of the United States Naval Observatory, in Washington, D. C., is one of the dictators. The other one is the precision clock which he is adjusting, a timepiece which runs inside a vacuum maintained in a glass case and which is operated by an electrically-driven pendulum. This clock, newly installed at the Observatory, is expected to run with an error of less than one hundredth of a second a day. The Observatory's clocks, corrected daily by observations of the stars, provide the standard for the time signals throughout the United States. Recent studies of the similar radio time signals arriving from Europe show slight variations with the direction of the wind, presumably due to effects of the weather on radio transmission.

not at all difficult for every one of them to arrive within a few moments of the appointed time. This would have been totally impossible for Julius Cæsar, or even for Napoleon Bonaparte, as countrywide agreement upon a time standard did not then exist. That it exists now is due to the astronomers and to the telegraph; the duty of the telegraph gradually has been passing, however, to radio broadcasting.

The development of the radio methods of exchanging time signals has not only become a great international convenience, but it has disclosed certain small variations of these signals, already much noticed in scientific news, which are now the subject of very active scientific investigation. In a recent report* on some of the work of the United States Coast and Geodetic Survey, Mr. Paul Sollenberger, of the United States Naval Observatory, describes recent developments of the time service maintained by that institution and mentions a most interesting correlation which has been discovered by Mr. J. E. Willis, of the Observatory, between the variations of the Washington-London time signals and the directions of the winds at the stations.

The variations between the times in London and in Washington are far too small to have great practical importance. They amount to only small fractions of a second. They are too large, however, to be blamed upon accidental error, either of the astronomers or of the apparatus. It is probable that they correspond to slight variations in the time required for the passage of radio waves between the two stations. A correlation with atmospheric conditions is, therefore, not unexpected. It is to be hoped that research will throw light on the relationship.

---

*"The United States Naval Observatory Time Service," by Paul Sollenberger. In "Geodetic Operations in the United States, January 1, 1924, to December 31, 1926," by William Bowie, published as Special Publication Number 134 of the United States Coast and Geodetic Survey, Washington, D. C., 1927, pages 24-25.

TRY IT 30 DAYS FREE

BEFORE YOU BUY

ALL METAL SHIELDED CHASSIS

8 tube~one dial

Only $69.75 Retail List Completely Assembled

MIRACO

TRADE MARK REGISTERED

MAGNIFICENT TONE~SUPER SELECTIVE~POWERFUL DISTANCE GETTER

All Electric~or Battery Set!

Big Discounts to User-Agents

MIRACO *Users Say*:

Reports from users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof and testimony of nearby users.

TRIED MANY SETS—MIRACO BEST

Miraco is best set I've ever heard. It's just the set I've always wanted and I've had so many sets I got just a little hard-boiled about believing there were any sets perfect. I sure got my wish. I've had just 104 stations. There's about a station to each number on dial. I get KFI (Cal.) every night. Had PWX last night and got 6KW tonight good and loud.—FRANCIS ARMBRUSTER, Cleveland, Ohio. P.S. You pack your sets wonderful.

HE KNOWS SETS—READ THIS

I have built radios since they first made their appearance and it has been my pleasure to build, repair and sell them. For quality, selectivity and sensitivity it is my firm belief that the Miraco cannot be excelled. I have proven beyond any shadow of doubt that it will outperform any other radios. I bring in the farthest distance with little or no effort. The Miraco also gives me tone quality.—URBAIN BARIL, Jr., Fall River, Mass.

MIRACO EXCELS EXPENSIVE RADIOS

The Miraco set and loud speaker beat anything around here, regardless of price. Have tried them out against a $200 outfit. Have logged 140 stations, coast to coast.—E. J. CARRIERE, Bathgate, N. D.

HEARS CUBA, CANADA, MEXICO

A friend visited here that has close to $300 in a radio—but no better tone and no plainer than the Miraco. Have gotten 118 stations. We get Mexico City, Winnipeg, Canada and Havana, Cuba—all of these so plain.—MRS. CLEM CORRELL, Morristown, Ind.

CUTS THRU NEW YORK LOCALS

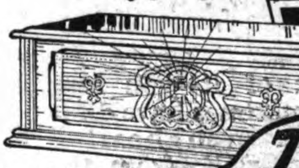
I can get distance thru the locals

America's big, old, reliable Radio Corporation* (8th successful year) **guarantees** in its big, powerful, latest 6, 7 and 8 tube Miraco sets "the finest, most enjoyable performance obtainable in **high grade** radios." Unless 30 days' use in your home fully satisfies you a Miraco is unbeatable at any price for beautiful, clear cathedral tone, razor-edge selectivity, powerful distance reception, easy operation, etc.—**don't buy it! Your verdict final.** Save or make lots of money on sets and equipment—write for testimony of nearby users and **Amazing Special Factory Offer.**

Miraco's work equally fine on "AC" electric house current or with batteries. Take your choice. Many thousands of Miraco users—who bought after thorough comparisons—enjoy programs Coast to Coast, Canada to Mexico, loud and clear—with the magnificent cathedral tone quality of costliest sets. Don't confuse Miraco's with cheap, "squawky" radios. Miraco's have finest parts, latest approved shielding, metal chassis, etc.—as used in many $200 sets.

Deal Direct with Big Factory

Your Miraco reaches you completely assembled, rigidly tested, fully guaranteed. Easy to connect and operate. **30 days' trial free.** 3 year guarantee if you buy. You take no risk, you insure satisfaction, you enjoy **rock-bottom money-saving prices** by dealing direct with one of radio's oldest, most successful builders of fine sets. 8th successful year in the radio manufacturing business.



MIRACO "Powerplus" sets—both in 8 and 7 tube models—have magnificently beautiful, clear cathedral tone quality. Turn one dial for stations everywhere. Ultra-selective. Miraco multi-stage distance amplification gives "power-plus" on far-off stations. Latest all-metal shielded chassis. Illuminated dial. Fully guaranteed. *Try one free for 30 days!* Choice of beautiful cabinets.

7 tube one dial
METAL SHIELDED CHASSIS
$49.75
RETAIL LIST

Electrify Any Radio *with* MIDWEST NO-BATTERY "AC" Light Socket Power Units

BIG DISCOUNT TO User-Agent

"A", "B" and "C" power, direct from light socket, without batteries! Write for Midwest prices and discounts. Midwest Units are highest grade—lastingly dependable, quiet in operation, fully guaranteed.

USER-AGENTS! Make big profits showing Miraco to friends. Get Our Special Wholesale Prices!
***MIDWEST RADIO CORPORATION, Cincinnati, O.**

Dealers Write!

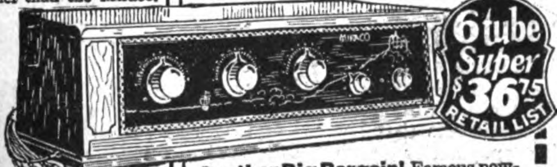
USERS' REPORTS PROVE THAT
MIRACO Radio gets 'em Coast to Coast

BEAUTIFULLY ILLUSTRATED CATALOG AND AMAZING SPECIAL OFFER

Free!

SEND NO MONEY—30 DAYS' TRIAL, Special Wholesale Price Offer to User-Agents, Bank References, testimony of nearby Miraco users—*all the proof you want*—sent with catalog.

mail coupon right now!



6 tube Super
$36.75
RETAIL LIST

Another Big Bargain! Famous powerful big Miraco Super 6, 1928 model—ultra selective! Thousands find it out-

MIDWEST RADIO CORPORATION
Pioneer Builders of Sets
479-K Miraco Building, Cincinnati, Ohio.

THIS COUPON IS NOT AN ORDER

Without obligation, send free catalog, AMAZING SPECIAL OFFER, testimony of nearby Miraco users. ☐ User ☐ Agent ☐ Dealer

NAME

The TEMPLE
air column speaker

The Ideal
Christmas Gift

Nothing will give greater pleasure in radio than a TEMPLE—the speaker that has been the sensation of every radio show, the joy of thousands of fans all over the country. Do your Christmas shopping early—buy a TEMPLE, Console or Drum Type Model. Either will bring you a richness and purity of tone reproduction that is far beyond what you ever thought was possible.

Heard Clearly Six Miles from Shore

Think of it—you fans who sometimes have difficulty in even hearing your own radio from the far end of the living room—the TEMPLE SPEAKER was heard six miles from shore—just as clearly as you hear a man speaking not six inches away! A wonderful test, yet on land or sea, in a living room or an auditorium, the TEMPLE never fails to give a richness and purity of tone that today is the talk of the radio world. Ask your dealer for a demonstration on the TEMPLE COMPARATOR.

Temple Models Priced at
$29.00—$37.50—$48.50—$65.00—$85.00

TEMPLE, INC.
213 S. Peoria St. Chicago

What's New in Radio

(*Continued from page 438*)

all well and good, providing he is willing to pay the price. But if one desires the most actual radio value for his money, he will do well to forget about great high-boy consoles and content himself with a smaller receiver which has all of its value in those things which go to make fine tone quality, sensitivity, selectivity and the other highly desirable features of the very best radio reception.

The Freed-Eisemann NR-9 receiver is just such a receiver. It is a six-valve set with three stages of tuned-high-frequency amplification, a detector and two stages of transformer-coupled, low-frequency amplification. It provides fine sensitivity and tone quality, is simple to operate and the volume of reproduction when turned up full is more than required for home use. Yet with all these good characteristics, the outside dimensions of the cabinet are only 20 inches in length by 10½ inches in depth by 10 inches in height. It is finished in dark-brown mahogany, with a front panel of the same material and color. The lines are graceful, and an effective contrasting note is obtained by the antique bronze escutcheon plate on the front panel. This plate bears all of the tuning and control knobs, as well as a pilot light window and a small window behind which the calibrated scale moves.

One reason for the great sensitivity of the NR-9 receiver lies in the inductively tuned antenna coupling. Instead of using the usual coil and condenser for this purpose, the variometer method of tuning is employed. The extreme efficiency of this system is generally recognized, but has not found extensive popularity because of difficulties encountered in designing a multi-stage amplifier of this type. Lack of selectivity has been a particular stumbling block. In the NR-9 receiver careful design has made the use of the inductive tuning entirely practicable for the antenna coupling and plenty of selectivity is obtained through the fact that three tuned circuits of the more usual type follow this inductively coupled circuit.

The low-frequency amplifier employs two stages of transformer coupling. The transformers used are sturdy products which provide uniform amplification of all tone frequencies. This is particularly true when a UX-171 type power amplifier valve is used in the last stage, because this valve is capable of handling the large volume of this receiver without overloading. A UX- or CX-112 type valve can be used and is quite satisfactory if the full volume of the receiver is not used—and in the home there will seldom be occasion to use full volume. A good reproducer should be used with the receiver; a reproducer marketed by the same manufacturer is recommended.

Either an indoor or outdoor antenna may be used. For local reception the former will in practically every case prove entirely satisfactory. For reception of distant stations an outdoor antenna is required, and it should be somewhere between 50 and 75 feet in length.

Standard UX- or CX-201-a type valves are employed in all stages except the last low-frequency stage, where either a UX-112 or the UX-171 type valve is required. Standard battery equipment is also used, or any good "A" or "B" power-packs. The Freed-Eisemann "B" and "C" power-pack is expressly designed for use with this receiver and will provide results at least equal to those from "B" and "C" batteries, without the necessity for replacement or attention. All connections between the receiver and the batteries are made by means of a cable made up of colored and coded wires. This comes with the receiver and leaves no opportunity for wrong connections.

Three knobs on the front panel control the tuning and operation of the receiver. The lower right-hand knob operates a combination battery switch and volume control rheostat. A pilot light shows when the receiver is "on" and "off."

The wavelength tuning is accomplished by means of the large center knob. This operates the three sharply tuned high-frequency circuits simultaneously. The tuning scale which moves behind the small window that is located just above this knob is calibrated both in degrees and directly in wavelengths. The broadly tuned antenna circuit is controlled by the left-hand knob, which surmounts a small lever switch that serves as an auxiliary antenna tuning device. This knob serves to regulate the sensitivity of the receiver and is a decided aid when it is desired to tune in weak, distant stations.

Maker: Freed-Eisemann Radio Corp.

A By-Pass Condenser That Saves Space

Name of instrument: Cartridge type by-pass condenser.

Description: This is one of the newer types of by-pass condensers that has found increasing popularity with builders of receivers. They occupy less sub-panel space for a given capacity than do condensers of the block type. The condenser proper is of the "wound" type and is made in a round roll. An edge of each of the two strips of foil which form the "plates" of this condenser is allowed to project beyond the edge of the paper strip which forms the dielectric. These edges project at opposite ends of the roll and the metal end-caps of the finished condenser are electrically soldered direct to the projecting edges, thus forming perfect contact. The metal end-caps then become the opposite terminals of the condenser.

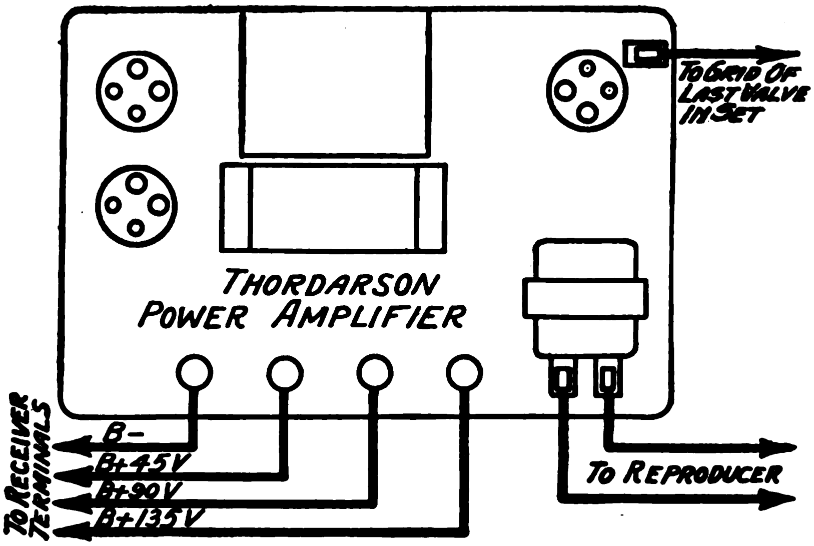
Usage: For any purpose where by-pass condensers of capacities from .1 mfd. to 2 mfds. are required.

Outstanding features: Compact. Easily mounted. Non-inductively wound.

Maker: Brown & Caine, Inc.

The Thordarson Power-Pack Amplifier

(*Continued from page 428*)



HOW TO HOOK UP THE UNIT

FIGURE 3: *This diagram gives the exact connections to the Crosley receiver, including the lead to the grid of the last valve, and the connections to reproducer.*

When the wiring has been completed and carefully checked, the unit is ready to be installed.

How to Install the Unit

The Thordarson unit may be used in connection with any receiver, to supply "B" voltages and a 210 power stage for the low-frequency amplifier. For the purposes of clearness, it is described here as used with the Crosley Bandbox, No. 601, a six-valve receiver of standard design. The installation of the unit in other standard receivers would not differ greatly from the procedure outlined here.

In setting up the Thordarson power amplifier with the Crosley receiver, first disconnect all the "B" batteries from the set cable. Then remove the "B" batteries from the radio table and place the new unit in their place. Next, connect up the cable wires to the four binding posts, I1, I2, I3 and I4, as indicated in Figure 3, and connect the reproducer to the two Fahnestock clips, J2 and J3, on the output transformer, C.

There is still one other connection to be made to the grid of the last valve in the Crosley set. To do this a simple plug can be made out of an old vacuum valve. Break the glass on a burned-out standard valve and clip off three of the wires left in the shell. The wire that connects to the grid terminal, however, should be left and a long extension wire soldered to it. Figure 4 shows the proper prong to connect this wire to. This plug should then be inserted in the last valve socket in the Crosley set. This socket is the one in the extreme right-hand front corner. The extension wire connected to this plug should then be run over and attached to the Fahnestock clip, J1, on the socket, D3.

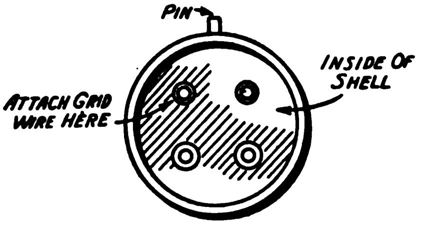
Next turn the receiver "on" in the regular manner and insert the plug on the lamp cord from the power compact, A, into a convenient AC lighting socket and turn the socket switch "on." Of course, a 216-b type rectifier valve should first be inserted in socket D1 in the unit, and an 874 voltage regulator valve in socket D2, and a 210 type power valve in socket D3.

The set is now ready to operate and no further adjustments are necessary.

Always remember, in putting the set into operation, first to turn "on" the switch on the Bandbox receiver and then turn "on" the power to the amplifier unit. In turning "off" the receiver, turn "off" the amplifier unit first and then turn "off" the switch on the receiver.

A surprising improvement in tone quality and volume will immediately be apparent, and the satisfaction in listening to the accompanying reception will be increased hundreds of per cent.

Radio dealers and service specialists will find that installations of this kind made for their customers will be extremely popular and profitable to themselves as well as to the users of the new amplifying apparatus.



FIGURD 4: *The lead from the power valve of the Thordarson unit to the last valve socket of the receiver should be attached to the grid prong of a plug made out of an old valve base as shown in this diagram.*

LYNCH

RESISTANCE The Control Valve of RADIO

Write for this book—

The famous Lynch 5-tube de luxe Deck. Simplifies home set-building at greatly reduced cost. Fully described in this booklet.

Learn the Usefulness *of* "Resistance *in* Radio"

RADIO fans, set-builders, and engineers will find a wealth of reliable, boiled-down, and interesting information in "Resistance the 'Control Valve' of Radio." Simply written and clearly illustrated. Concisely presents the latest information on resistance coupled amplification, the function of resistance in a circuit, circuit arrangements on equalizors, and other radio matters of interest and importance. This valuable handbook on resistance in radio is worth dollars—you can get a copy for only 25 cents.

ARTHUR H. LYNCH, Inc.
1775 Broadway at 57th Street
General Motors Building, New York, N. Y.
Sales offices in most large cities

Mr. Arthur H. Lynch,
1775 Broadway,
New York City

Dear Mr. Lynch:

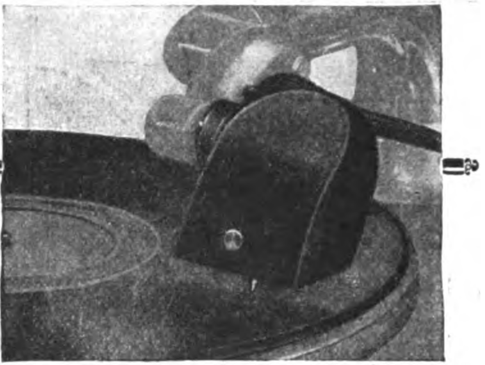
Please send me a copy of your new booklet "Resistance the 'Control Valve' of Radio." I am enclosing 25 cents.

Name..............................

Street..............................

City....................*State*.......

P. R.



$12.50
Complete

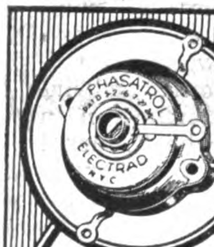
Use your Radio to electrify your phonograph —*attach the* Pacent PHONOVOX

YOU WILL experience a revelation in phonograph reproduction when you have heard your favorite records reproduced through the Pacent PHONOVOX—a better phonograph pick-up device.

Ask your dealer to demonstrate this greatest radio-phonograph accessory of the year! See how easily and quickly it is attached—without tools or changes in wiring! He will gladly show you how you can secure the equivalent of electric phonograph reproduction at a cost of only $12.50.

Sold and demonstrated by dealers everywhere

PACENT RADIO CORPORATION
156 West 16th Street New York
Makers of the famous Pacent Balanced Cone



Licensed by Rider Radio Corporation.
Pats. Pending.
Patented 5-2-'16.
Patented 7-27-'26.

Oscillations! Spoil Reception —Stop them!

"Phasatrol"
Reg. U. S. Pat. Off.

A true balancing device for Radio frequency amplifiers

Price - - $2.75

Thousands of radio fans are solving their problem of R. F. oscillation by installing Phasatrols.

This highly perfected instrument eliminates oscillations permanently—is very easy to install—and makes tuning for distance an easy matter.

Write for free hook-up circular for any set or circuit

Dept. 58C, 175 Varick St., New York, N. Y.

ELECTRAD Inc.

AMPERITE is the only automatic filament control that keeps the temperature or voltage of the tube filament constant despite variations in the "A" battery voltage. It guarantees improved tube performance and increased tube life through always operating tubes at their proper filament temperature. Simplifies wiring, panel design, tube control, tuning. Eliminates hand rheostats. Do not confuse with fixed filament resistors which attempt to imitate AMPERITE but are entirely different in principle and operation. Insist upon *Amperite*. Price $1.10 mounted (in U.S.A.) For sale by all dealers.

Write for FREE "Amperite Book" of season's best circuits and latest construction data.
Address Dept. PR12

Radiall Company
50 FRANKLIN ST., NEW YORK

AMPERITE
REG. U.S. PAT. OFF.
The "SELF-ADJUSTING" *Rheostat*

What's New in Radio

(Continued from page 440)

the receiver, and from this point on this knob serves as the volume control. When turned all the way to the right, maximum volume is obtained; this may be shaded down to any desired degree by simply turning this knob to the left. When turned all the way to the left, the receiver is turned "off."

All wavelength tuning of the three high-frequency stages and the detector stage is accomplished simultaneously with the lower right-hand knob. It also drives the drum which is located behind the illuminated escutcheon plate and which is calibrated directly in wavelengths. The drum lamp is operated by the same switch that turns the receiver "on" and "off," and it therefore serves as a pilot light.

The tuning condensers of the four tuned circuits are located in a shielded compartment just inside of the front panel. All other parts and instruments are located or mounted on a composition sub-panel, which in turn is mounted on a metal frame that serves both as a rigid foundation for the chassis and also as a partial shield. This metal framework, and the metal case which incloses the condenser assembly, constitutes a complete cover for everything except the valves, which are mounted on top of the composition sub-panel.

The high-frequency portion of the receiver is well stabilized by a method not disclosed by the manufacturer. The coupling transformers of the "binocular" type minimize undesirable interstage coupling and direct pick-up. Thus all of the signal energy coming into the receiver must come by way of the antenna and is therefore subjected to the full tuning action of the four tuned circuits. This is one of the reasons for the high degree of selectivity obtained in this receiver.

In the low-frequency amplifier two transformers of good characteristics are employed, with the result that the overall tone quality is of a high order. There is also ample volume for all ordinary purposes.

The receiver is designed for the use of standard UX-201-a type valves in all sockets except the last low-frequency stage, where either a UX-112 type or a UX-171 type valve may be used. Separate "B" and "C" connection wires are provided in the battery cable for this stage to permit the use of "B" and "C" voltages to correspond with the type of valve used in this stage.

Inside of the receiver, at the rear, binding posts are provided for the connections to antenna and ground. There is also a pair of tip jacks for connecting the reproducer. All battery connections are made by means of a battery cable, the receiver end of which is permanently connected directly to the circuit inside of the receiver. Each of the wires in the cable is distinctly marked so there can be no error in making the connections to the batteries.

While operating the receiver in New York City no difficulty was found in bringing in, without any trace of interference, distant stations which operate within 20 kilocycles of powerful local stations. This is entirely adequate selectivity even for city use. The sensitivity of the receiver was also found to be above average.

Maker: Pfanstiehl Radio Co.

Peppy Batteries always . . . . *if the Christmas list includes a General Electric battery charger!*

Tungar (the name of the General Electric Battery Charger)—put that on your list. For Dad, or Jack . . . or maybe, just for yourself. Every radio set should have its Tungar to keep batteries always pepped up.

The two-ampere Tungar has been a particular favorite because it gives both trickle and boost charging rates.

But different sets really require different chargers. Your radio dealer will tell you which is best for your set. Now that Tungar prices are lower than ever before, be sure you settle your battery charging problems for all time. And do as much for all the other radio fans on your Christmas list.

Tungar causes no radio interference. It cannot blow out tubes.

An overnight charge costs about a dime.

It is a G-E product developed in the Research Laboratories of General Electric.

The 2-or 5-ampere Tungars charge 2-, 4-, and 6-volt "A" batteries, 24- to 96-volt "B" batteries, in series; and auto batteries, too. No extra attachments needed.

GE **Tungar**
REG. U.S. PAT. OFF.
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

New low prices
East of the Rockies

2-AMP. TUNGAR	$14
5-AMP. TUNGAR	$24
TRICKLE TUNGAR	$10

Merchandise Department
General Electric Company
Bridgeport, Connecticut

GENERAL ELECTRIC

1
3
4
5
6
7
8
2
ANTENNA COUPLER
DETECTOR TUNER

THE
"LYNCH 5"
model was built around
SICKLES COILS
You can expect to duplicate the exceptional results only with the same
SICKLES COILS
These are the same standard high quality accurately calibrated coils which have had no superior during the past five years. Specially designed for the
"LYNCH 5"
Coil Set No. 28, $4.50
There are Sickles Diamond-Weave Coils for all leading circuits.

THE F. W. SICKLES CO.
134 UNION STREET
SPRINGFIELD :: MASS.

No.		Coil Prices
30	Shielded Transformer	$2.00 each
24	Browning-Drake	7.50 set
18A	Roberts Circuit	8.00 set
25	Aristocrat Circuit	8.00 set
28	Lynch 5	4.50 set

6 TUBE RADIO
ONE DIAL
Only $32.50
Latest advanced circuit. All-steel chassis, totally shielded. Balanced parts of best quality. Marvelous power and selectivity. Gets the long-range stations as clear as a bell. One-dial single control. Encased in cabinet of fine finish and rare beauty. Here is a value unsurpassed in the realm of radio—just one of the mighty bargains listed in my new catalog. Get full details before you buy any radio. An unsurpassed value—just one of our many mighty bargains.

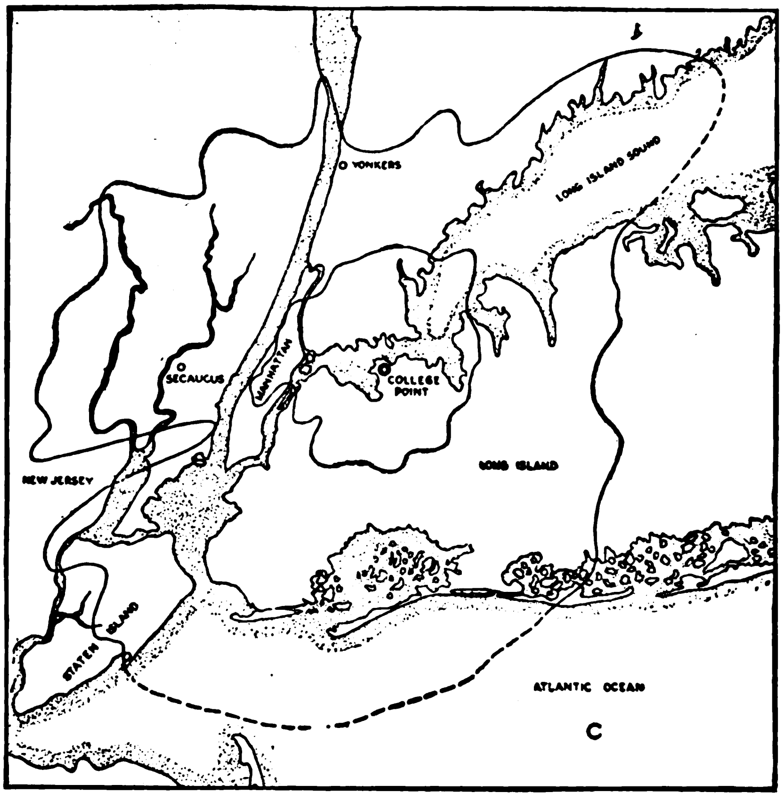
FREE Catalog, Log and Call Book

It's just off the press! Chock-full of radio's latest and best 1928 developments. 132 pages of real radio information. Lists all the latest receivers, eliminators, chargers, speakers, kits, parts, etc. All the radio stations and newly assigned wave lengths. A regular encyclopedia of Radio information. And it's Free! Send for your copy today.
AMERICAN RADIO BARGAINS

AMERICAN
AUTO & RADIO MFG. CO.
Harry Schwartzberg, *Pres.*
Dept. 202 American Radio Bldg., Kansas City, Mo.

If You Live in a Building With Steel Framework—

(*Continued from page 450*)



RADIO "SHADOWS" CAST BY TALL BUILDINGS

FIGURE 6: *The light black lines connect places where the signal strength of the experimental station at College Point was equal. The deep indentation of the line in New Jersey shows that the tall buildings of lower Manhattan absorbed much of the energy of the broadcasting station, so that receivers in this part of New Jersey had much poorer reception than other places equally distant from the transmitting station.*

strength for typical rooms which have windows opening directly outward are also given on the diagram.

In the case of a typical modern steel apartment house, the interior signal strength may be reduced to but a few per cent of that outside the building. Measurements illustrating this fact are given in Figure 2.

For example, the field strength on the ground floor at the foot of the elevator shaft was found to be but 1/100 of that of the open roof. In such a building the presence of a window in the room has a very noticeable effect. For outside rooms, the field strength near the window was found to be about eight times as great as that along the farther wall. It is almost as though the broadcast waves blew in at the window like a breeze that puffs out curtains and draperies before it. But, of course, to obtain the broadcast breeze it is not necessary to have the window open.

Such severe shielding effects as those indicated in Figure 2 obviously suggest the desirability of an outdoor antenna, with means for connecting it to the radio set by wire circuits, preferably by shielded circuits, in order to protect against local interference.

A New Leaf for the New Year

The new year always brings new resolutions, and POPULAR RADIO'S promise to its readers for 1928 is a bigger magazine, with more articles, more varied subjects, and a snappier, crisper presentation of facts than ever before. Let the January number prove this to you—the biggest issue of the magazine ever published in its appeal to all types of radio enthusiasts.

The New Science of Soldering

(*Continued from page 434*)

metals other than tin or lead. Such a condition of the alloy will react by raising the melting point, detract from the strength of the solder bond and generally result in difficulty in working the alloy. Solder may be procured in a variety of different forms, but the home constructor of radio apparatus has most generally adopted the wire or ribbon form. This type is made in two ways—either solid or tubular. The tubular type has within its walls a rosin flux. Thus it offers the constructor a unique labor-saving combination of the two essentials for wire connecting—solder and flux.

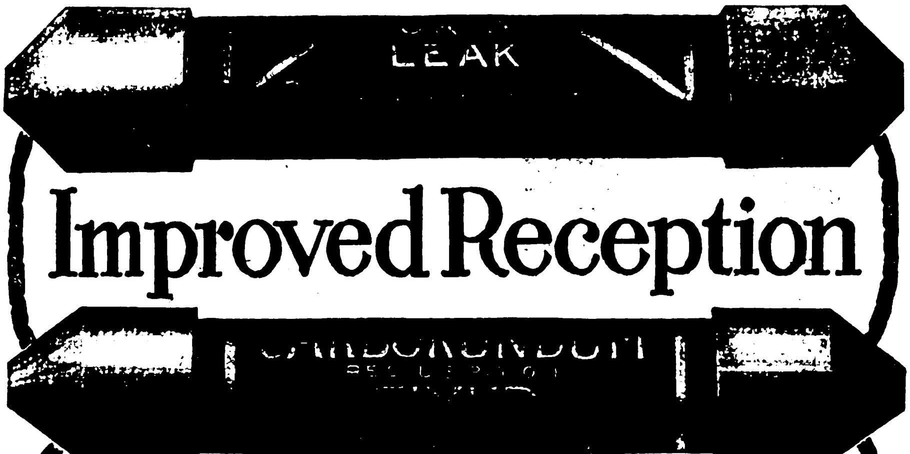
Just why is solder used? Many radio fans look on it merely as a sort of metal glue for binding together similar dissimilar metals. If this were all that it did, bolting, riveting or welding would accomplish the same result. But whenever we weld, rivet or otherwise mechanically join two metals, oxygen may penetrate to the surfaces of their contact, coating the metals with a film of metallic oxides that offers undesirable electrical resistance.

The more delicate the current to be controlled, the greater is the necessity for oxygen exclusion from vital connections in conductors. Furthermore, all metals under the influence of temperature-change react with an accompanying expansion and contraction. This is more pronounced in some metals than in others. Let us suppose that in the formation of a mechanical connection two different metals are employed, one displaying a greater co-efficient of expansion than the other. As the radio receiver may be exposed to varying temperatures, this mechanical connection will be constantly in motion until a connection is loosened.

In the alloy solder we have a material that furnishes us with a means of defeating all these undermining factors of good radio reception. It is a tenacious, flexible bonding medium that will readily yield to the various strains and stresses, as well as form an impenetrable barrier against the encroachment of atmospheric oxygen.

To illustrate better the seriousness of an unsoldered joint in radio-receiver construction, consider the fact that ten such joints increase the resistance in the conductors four times in less than three months. On the other hand, the same joints, if properly soldered, will lower the resistance in the joints so protected to approximately 60 per cent of the resistance offered by the conductor itself.

So for your next set make it a point to solder-bond every connection you possibly can, for this will mean increased range and more volume.



Improved Reception

Get it with the

CARBORUNDUM
REG. U. S. PAT. OFF.
GRID LEAK

ONE certain way of getting better and clearer reception is to slip a Carborundum Grid Leak into your set.

¶Things will quiet down instantly. Carborundum Grid Leaks do not disintegrate—hence they are quiet. They are solid, fixed, dense rods of Carborundum. They assure an uninterrupted flow of current. They banish Grid Leak noises.

¶Carborundum Grid Leaks are tested at 5 volts—the plate resistors at 90 volts.

From your dealer, or direct
Send for Hook-Up Booklet D-5

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.
CANADIAN CARBORUNDUM CO., LTD., NIAGARA FALLS, ONT.
Sales Offices and Warehouses in New York, Chicago, Boston, Philadelphia, Cleveland, Detroit
Cincinnati, Pittsburgh, Grand Rapids, Milwaukee
The Carborundum Co., Ltd., Manchester, Eng.
Deutsche Carborundum Werke, Dusseldorf, Ger.

Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of The Carborundum Company.

POPULAR RADIO DEALER AND JOBBER
LISTS AVAILABLE TO MANUFACTURERS

The Service Bureau of POPULAR RADIO is able to place at the disposal of radio manufacturers a list of over 21,000 radio dealers, 3,926 radio manufacturers, 1,746 jobbers and 326 manufacturers' representatives. These addresses are immediately available for circularizing prospects for new Fall lines, and more detailed information and rates will be gladly supplied to those who wish to take advantage of what is without doubt one of the most carefully kept lists at present offered for use.

Address all inquiries to:

SERVICE BUREAU

POPULAR RADIO, Inc.
119 West 57th Street New York, N. Y.

Constant Accuracy!

TRUVOLT

An All-Wire Variable Voltage Control

Install Truvolt in the B-Eliminator you are constructing and vary your voltage exactly. A new type wire variable high resistance kept cool by its greater radiation surface—like an air-cooled motor.

Develops but ½ the temperature of other resistances of like size; hence is permanently accurate and lasts indefinitely. Positive metallic contact always and 30 exact readings of resistance.

Type	Resistance (ohms)	Current (Milliamperes)
T-5	0 to 500	224
T-10	0 to 1,000	158
T-20	0 to 2,000	112
T-50	0 to 5,000	71
T-100	0 to 10,000	50
T-200	0 to 20,000	35
T-250	0 to 25,000	32
T-500	0 to 50,000	22.5

Price $3.50 each
All rated at 25 watts.
At your dealers.

Also a full line of Wire Fixed Resistances.

Write for free hook-up circular

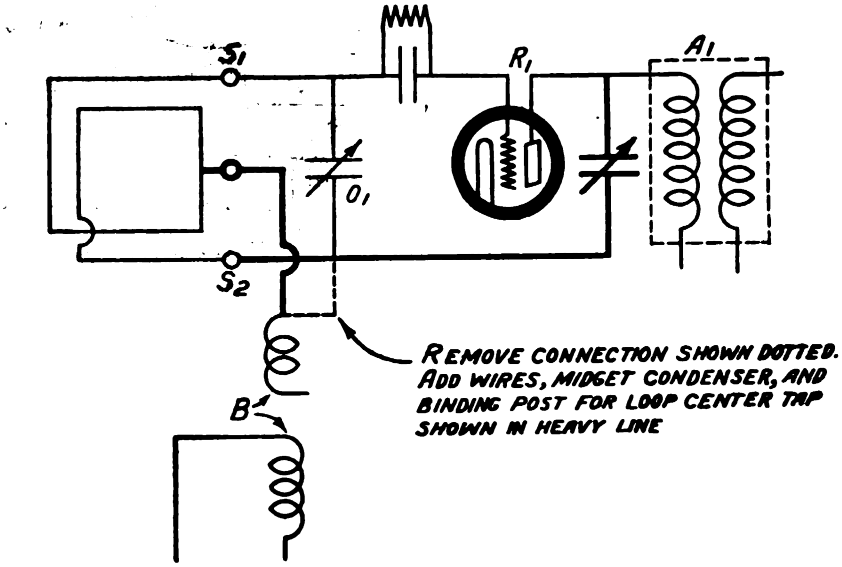
"This Is An Eliminator Year"

Dept. 18-B, 175 Varick Street,
New York, N. Y.

ELECTRAD INC

Operating the Magnaformer

(Continued from page 424)


S1
R1
A1
O1
S2
B
REMOVE CONNECTION SHOWN DOTTED. ADD WIRES, MIDGET CONDENSER, AND BINDING POST FOR LOOP CENTER TAP SHOWN IN HEAVY LINE

HOW TO ADD REGENERATION IN THE LOOP CIRCUIT

FIGURE 2: *This simple drawing shows the added wiring and the small, midget condenser, as well as a center binding post for the loop, in heavy black lines. The only wire that should be removed is that shown in dotted lines. The midget condenser will then control regeneration in an efficient and simple manner. This addition will help in extreme long-distance reception.*

ity are to be attained. But the Magnaformer 9-8 receiver does not require this external bolstering up of efficiency. The receiver is designed to provide all the selectivity and sensitivity that will ever be required.

It is realized, however, that there are many experimenters who are interested in trying all the tricks, and for them a diagram is shown, in Figure 2, covering the changes needed to add this regenerative feature.

The only changes involved are easily made. They consist of the addition of one more small jack for the third loop connection in the receiver, and the installation of a .00005 mfd. midget variable condenser. The original connections for the loop are shown in Figure 1. In Figure 2 is shown the revised connections in heavy lines. The tuning condenser is left connected across the entire loop as before, but the connection from the pick-up coil should be changed over to the middle loop terminal. The midget condenser which controls regeneration is then connected between the plate of the detector valve and the end terminal of the loop which before connected to the pick-up coil.

The third jack for the loop can be mounted at any convenient point on the sub-panel, but close to the other two jacks. The midget condenser may be mounted either on the front panel or, to avoid spoiling the symmetrical appearance of the panel, it can be mounted on a little shelf fastened on the inside of the left-hand end of the cabinet, just below the top. This latter arrangement is recommended because it will not alter the external appearance of the receiver, yet the regeneration control will be readily accessible.

For those who desire additional information on the construction and operation of the Magnaformer receiver, complete, full-size blueprints, with constructional and operating data, may be obtained from the manufacturer.

SUPER RECEPTION COMES INTO ITS OWN—

—with the new Victoreen 8-valve superheterodyne receiver. The January number of POPULAR RADIO will give complete constructional details for this new set, that embodies all the 1928 innovations in design and construction, both in the intermediate and low-frequency amplifiers. Superheterodyne fans cannot fail to be interested in this receiver.

A Real Romance of Radio

"THIS is station KFKX, Hastings, Nebraska. The next selection will be a violin duet by William and Edward Zimmer, father and son."

Marvelous as radio is, it is no more marvelous than the tale that lies behind the harmony of those two violins—a tale of real life, written in bitter and happy experiences of twenty years.

William Zimmer, a violinist educated in Berlin, fell in love with a sixteen-year-old girl in New York City and, after a whirlwind courtship, he married her. Their cup of joy seemed full when their baby came. The boy, who was named Edward, was about nine months old when Zimmer went on the road with a musical comedy company.

But he failed to return.

In time Mrs. Zimmer got a divorce and married a wealthy cotton broker named Mack.

The family moved to St. Louis, and Edward, who had shown real talent on the violin, made his *début* over the radio. He and his mother had often heard his father playing over the radio at Hastings, Nebraska.

Adverse business conditions developed and the Mack fortune was swept away. The mother realized that Edward's musical education must come to an end unless, in some way, the boy's father would help. And she devised a unique plan.

Under the name of "Edward Mack," she sent the son to Hastings to take violin lessons of his father.

Edward protested against the idea at first; he didn't care to know a father who had deserted him as a baby. But finally, to please his mother, he went.

The father tells the rest of the story:

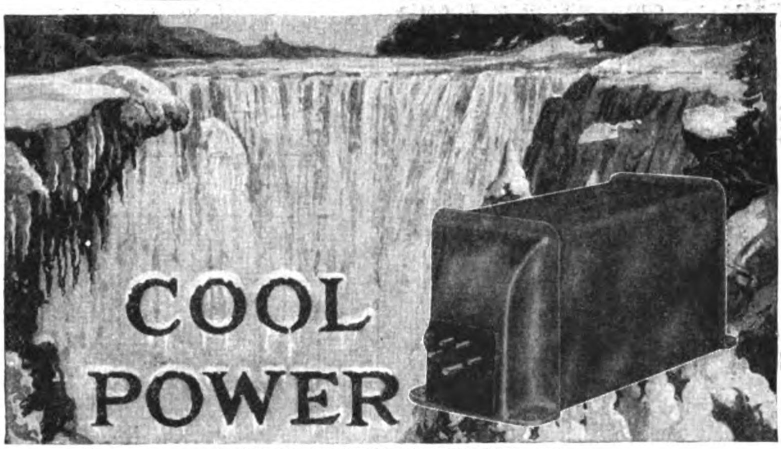
"He had been taking music lessons of me for several weeks, and, of course, I had not recognized him. I hadn't even seen him since he was nine months old. I had worried about him and wondered about him; and I wasn't so proud of the way I had acted years before.

"Then, one day, as I was giving him his lesson, I noticed tears in his eyes.

"'You are homesick for your folks,' I said. He had told me they were coming to Hastings in a short time. I threw my arm across his shoulder to comfort him, and then he broke down and told me the whole story. I was never so happy in my life!

"I then had told my present wife all about my first marriage and she insisted that Edward come into our home. He is a wonderful violinist. He plays in the orchestra I direct and I give him the solo parts, for he is a much better musician than I am. At the close of the season I shall take him to New York with me to study. I am in a position to help him now and it is my turn to do something."

—BERTHA STREETER



SAMSON POWER BLOCK NO. 210
The only block which will supply 500 volts at 80 mils to two 210 tubes

Powerize with Samson Units for Best Results

For new SAMSON Power Units insure the best there is in radio current supply by

1. Doing away with hum, motor boating and poor voltage regulation.
2. Remaining so cool after 24 hours continuous operation under full load that they will be well within the 20° rise of temperature specified by the A. I. E. E.
3. Being designed to more than meet the specifications adopted by the National Board of Fire Underwriters.
4. Insuring safety against shock because of protected input and output terminals.
5. Insuring for all tubes the correct filament voltages specified by their manufacturers.
6. Compensating for lighting circuit voltage variation by the use of a special input plug and terminal block to which is attached a 6 ft. flexible rubber-covered connecting cord and plug.

Our Power Units bulletin descriptive of these is free for the asking. In addition, our construction bulletin on many different "B" Eliminators and Power Amplifiers will be sent upon receipt of ten cents in stamps to cover the mailing cost.

SAMSON ELECTRIC COMPANY

Manufacturers Since 1882 **Principal Office: Canton, Mass.**

We offer **COMPLETE PARTS** *for*

SILVER-MARSHALL
IMPROVED LABORATORY
8 TUBE A. C. SUPER

WESTERN RADIO offers its usual prompt, efficient service on this new circuit—we stock all parts for it. The big Western catalog also lists—at lowest prices—complete parts for all the popular kits—as well as a full line of sets, parts and accessories.

***Dealers write for our* BIG CATALOG!**

WESTERN
RADIO MANUFACTURING COMPANY
136 West Lake Street Dept. 51 Chicago

CARTER

Fixed Condensers

Rheostats

Switches

Jacks

—As Usual—

Specified for

Dependable Performance in

Improved Laboratory

AC Super

At your dealers

In Canada: Carter Radio Co., Ltd., Toronto

Offices in principal cities of the world

Carter Radio Co.
CHICAGO

ARE YOU PAYING TOO MUCH

If you are a dealer, investigate! If your competitor is buying for cash from The Harry Alter Co., he is paying less and making more profit on receiving sets, kits, parts and accessories of every kind. And he is getting "same day" shipments from America's largest stock.

Write for Harry Alter's New "Radio Book"

Compare its rock-bottom wholesale prices for your own protection. Sent free to retailers only. Write today.

The Harry Alter Co.

1755 Michigan Ave., Chicago

MAIL THIS COUPON

The Harry Alter Co.,
1755 Michigan Ave., Chicago

Send at once a copy of your December price guide.

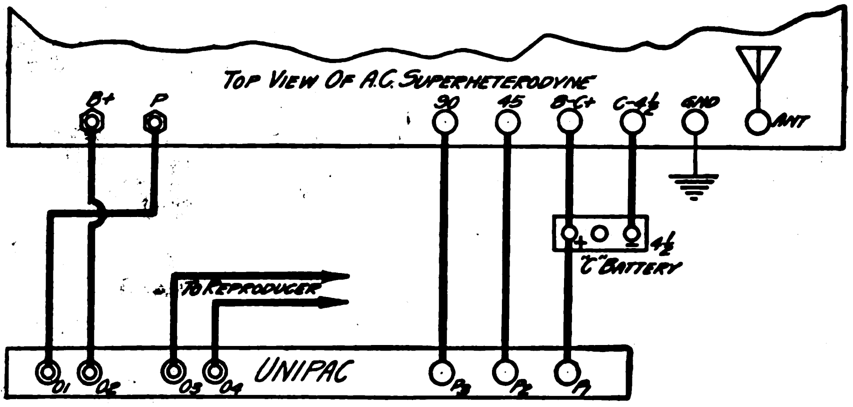
Name...

Address..

City..............................**State**...............

The New AC Superheterodyne

(*Continued from page 414*)



THE CONNECTION DIAGRAM

FIGURE 5: *This diagram gives the hook-up between the superheterodyne intermediate-frequency pack and the LC-28 Unipac, that contains the complete low-frequency power amplifier. One small 4½ volt "C" battery is required*

The wiring of the heater circuit, including the twisted pair of wires that run from the transformer to the heater terminals located on top of the AC valves, is not shown completely on the picture-wiring diagram, but is given in a separate diagram shown in Figure 6. This wire should be of twisted lamp cord of sufficient conductivity to carry 7 or 8 amperes. All of the heater terminals are connected in parallel, with the lamp cord twisted in the span between each valve.

When the wiring, as shown in Figure 4, is complete, the circuit shown in the schematic diagram in Figure 1, has been carried out, and the receiver is ready to be used.

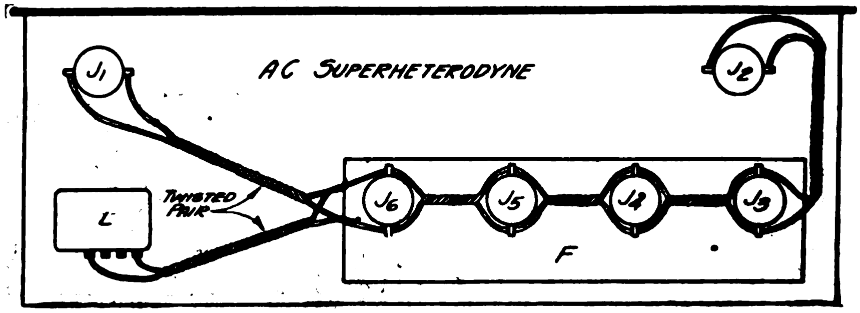
How to Install the Set

The superheterodyne high-frequency pack that has just been completed may be slipped into the cabinet or console chosen for it, according to the builder's taste, and the LC-28 Unipac, that was fully described in the November, 1927, issue of POPULAR RADIO, should be set up underneath it in the radio table or the lower part of the console. The LC-28 Unipac will furnish complete "B" voltages for the high-frequency pack and will furnish two stages of low-frequency amplification with a power-operated last stage.

Six Sovereign AC valves should be inserted in the sockets, J1, J2, J3, J4, J5 and J6, with the AC harness attached. The heater terminals of these AC valves are in the form of 6-32 machine screws, and ordinary nuts and lock washers may be used to fasten on the heater wires. It is best to solder copper terminals or soldering lugs onto the wires, in the correct positions, and then screw them down tight on the heater terminals of the valves.

Next place a Magnatron AC-226 type AC valve in socket I in the Unipac. Place a 210 type power valve in socket H of the Unipac. Place an 874 type glow valve in socket G. Then place two 216-b type rectifier valves in sockets F1 and F2. Refer to the article on the LC-28 Unipac in the November, 1927, issue of POPULAR RADIO for the designations for the sockets.

The two units may now be connected together in the manner shown in Figure 5. This gives the hook-up between the AC superheterodyne and the LC-28 Unipac, including the connections to the antenna and ground, and to the reproducer. It is recommended that a Farrand Eliptical cone or a Western Electric cone reproducer be used with this receiver on account of the response curve of the amplifier in combination



HOW TO CONNECT THE HEATER CIRCUIT

FIGURE 6: *In this diagram the arrangement of the heater cables is shown clearly. All of the AC valve heaters are connected in parallel, and get their current supply from the two outside terminals of the heater transformer, L*

with the response curve of these particular loudspeakers. These combinations work out well, giving excellent response for the entire audible range.

The combination is now ready for operation and the switch, O, on the superheterodyne may be turned "on," causing the heaters of the six AC valves to warm up.

Then the switch at the lamp socket feeding the LC-28 Unipac may be turned "on" and the amplifier will commence to function.

The sensitivity control, E, on the superheterodyne should be turned about half way. Then the two dials, N and P, may also be set about half way, and the two drum dials, K1 and K2, revolved in unison until a signal is picked up.

Both the volume and the quality may then be adjusted to the operator's taste by the three controls, E, N and P. There will be no other adjustments to be made either in the set or in the Unipac and all that will be necessary to do to tune in other stations will be to revolve the two dials, A1 and A2, and to make the adjustments on the three middle controls as indicated by their designations on the front panel; one for sensitivity, one for gain and one for filament adjustment.

It should be remembered in turning the set "on" or "off" that the filament switch on the set should be turned "on" first and then the Unipac should be turned "on." The Unipac should be turned "off" first and then the switch on the superheterodyne should be turned "off."

The sensitivity of the new receiver and its excellent tone quality, together with its ease of control, and the complete absence of worry or bother in upkeep of batteries or charging, should make the receiver a popular one with broadcast listeners, and especially those who want an ultra-sensitive superheterodyne of the most modern design.

The Octa-monic Circuit

(Continued from page 427)

The Octa-monic, as shown in Figure 2, is subject to some limitation in regard to sensitivity, as the signal strength of the incoming carrier wave must be sufficient to operate the grid to a point where unequal amplification occurs and harmonics are generated. This means that extremely weak signals will not operate the harmonic valve and accordingly will not be heard. Some method of amplification must be employed ahead of the harmonic generator to insure the pick-up of weak signals. Such an amplifying system does not have to possess any particular selectivity, since selectivity is obtained by the harmonic principle. Amplification alone is the only consideration for this part of the high-frequency circuit.

NATIONAL

NATIONAL-B

Type 7180— A "B" That's Built for Service

A Strictly Heavy-Duty Power-Unit Supplying

Detector Voltages—22 to 45 adjustable
R. F. Voltages—50 to 75 adjustable
A. F. Voltages—90 to 135 adjustable
Power Tube Voltage—180—fixed

Protects Tubes, Condensers against excessive and harmful voltages. Designed for lasting service with liberal factors of safety.

Rating

Output rating is 70 mils at 180 volts. Uses R. C. A. UX 280 or Cunningham CX 380 Rectifying Tube.

Licensed Under Patents of Radio Corporation of America and Associated Companies. For 110-120 volts, 50-60 cycles A. C. only.

List Price with Cord, Switch and Plug $40.00. Rectifier Tube $5.00.

Write National Co., Inc., W. A. Ready, Pres., Malden, Mass., for new Bulletin 124

NATIONAL POWER TRANSFORMERS and FILTER CHOKES for AMPLIFIERS

Specified generally. Transformer Type R, center tapped 600 v. secondary. Price $12.50. Transformer Type U, both 600 and 460 v. secondary $14.50.

NATIONAL FILTER CHOKES, per pair in heavy case, Type 80, $10.00.

TONE FILTER FOR BETTER TONE AND SPEAKER PROTECTION
FILAMENT TRANSFORMER NO. 122 FOR THE NEW A.C. TUBES
EQUITUNE VARIABLE CONDENSER
R-13 BATTERY CHARGER 2½ AMPERES
THE ORIGINAL VELVET VERNIER DIAL TYPE A
POWER TRANSFORMER FOR PLATE SUPPLY UNITS
R-26 BATTERY-CHARGER 2½ TO 5 AMPERES
IMPEDAFORMER FOR QUALITY AUDIO
PHONOGRAPH SCRATCH FILTER
SPECIAL CONDENSER BLOCK
ILLUMINATED VELVET VERNIER DIAL TYPE C
FILTER CHOKES TYPE 80

NATIONAL TUNING UNITS — THE HEAVENLY TWINS
More National Tuning Units have been used by set builders than all other similar components combined.
Standard since 1923 Approved By BROWNING & DRAKE The OFFICIAL Design.

Digitized by Google

SANGAMO
AUDIO TRANSFORMERS
Uniform Amplification
Over Entire Musical Scale

Every note and every delicate variation in tone is reproduced with flawless realism when the new Sangamo Audio Transformer is used in an appropriate circuit. Even the ear of a highly trained musician cannot distinguish between the reproduction and the original.

Best results are obtained by using two Sangamo Audio Transformers (one in each stage) but one will improve any good amplifier. A power tube should be used in the last stage.

Completely shielded. Tested at equivalent of 1,000 volts d. c. between windings and between each winding and case.

3 to 1 ratio. Price, $10

Sangamo Mica Condensers are accurate and stay accurate.

Sangamo Electric Company
Springfield, Ill.

RADIO CATALOG free

2000 Exceptional Radio Values

1928 WHOLESALE CATALOG of RADIO Sets, Kits and Everything in Radio

LOWEST PRICES to DEALERS

Every Set Builder Needs This Book

Make This a Big Radio Season!

Every live dealer in radio sets, parts, accessories, supplies, etc., should have a copy of this bargain catalog. You will be amazed at the thousands of money-saving radio items illustrated and listed in this storehouse of everything you could possibly need in radio.

The GUIDE BOOK to Bigger RADIO PROFITS FOR YOU

The book contains all the latest and most popular kits—all the famous, nationally known radio parts, accessories and supplies—the very newest types and designs of table cabinets and consoles—everything at prices that mean bigger profits for you.

Short Wave Section Our catalog contains a section devoted to a showing of the highest grade short wave receiving and transmitting apparatus. Also the finest electrical appliances for use in the home.

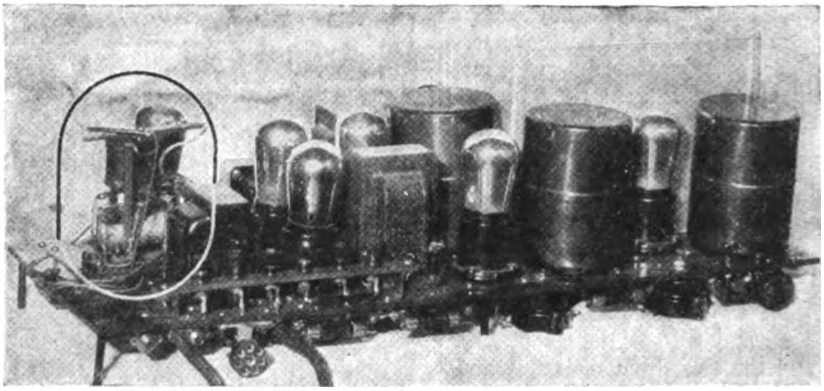
Dealers Make More Money! Tie up with a house that carries large, complete stocks, that gives you the highest quality radio parts, that insures speedy shipments and 100% satisfactory service.

Our wholesale vest pocket price list and discount sheet and catalog will be sent to you on request.

BUT WRITE QUICKLY
SHURE RADIO COMPANY
341U West Madison Street Chicago, Illinois

Tuning with a Push Button

(Continued from page 422)



A SELF-TUNING RECEIVER

FIGURE 2: *The automatic tuning receiver perfected by Mr. Burns is shown here without the cabinet, so as to give an idea of the layout of the instruments. The tuner valve and relay which actuates the tuning motor are in the circle at the left.*

eration, such as either releasing or pressing a push button, we may have a remote control device, but not an automatic tuner. Third, when the tuning unit is in resonance with received signals, it must be possible to start the movement again, so that the tuner will go on to signals of another frequency, by simply pressing the button. A self-tuner, therefore, includes three units: first, a motor unit which can be set in operation by the simple act of pressing a button and which will operate the moving part of the tuning unit; second, a relay actuated by voltage or plate current variations at resonance and which will stop the motor and hold the tuning unit as soon as it reaches a point of resonance. The relay and motor mechanism should act in a very small fraction of a second, so that the tuning unit will not be carried beyond the point of resonance before the stopping mechanism acts. There must also be a reset unit to start the motor unit again in action. The relay and reset units can be combined in one, as will be shown.

I shall describe the self-tuner as applied to capacity tuning, though it would apply as well to inductance tuning.

The motor unit which we used turns the condenser plates at the rate of one revolution per minute. No gearing is necessary, as the shaft of the motor unit has a speed of 1 r.p.m. The motor unit shaft is connected directly to the condenser shaft. The motor is synchronous and the minute gearing, in a ratio of 3,600 to 1, which is a part of the motor unit, is completely enclosed in the same housing with the motor armature.

To make clear the operation of the relay in our self-tuner, it will be necessary to review the action in the plate circuit of an amplifier valve. The variations in grid voltage produced by received signals cause variations of plate current above and below a constant mean value. This constant mean value is the DC component. If the valve is operated on the straight portion of its characteristic curve, the plate current increases just as much above the mean value as it decreases below that value, and the positive and negative amplitudes are equal, so the average value of the plate current remains constant. This is shown at A in Figure 1. If, however, the action takes place near the lower bend of the curve, the increase above the average value is greater than the decrease below that value, the positive amplitude is greater than the negative amplitude, so that while impulses are coming in there is an increase in the average value of the plate current. This is shown at B in Figure 1. Whether the valve operates on the straight portion or the bend of the curve depends on the plate and grid voltages, so that it is a simple matter to adjust the action of the valve to the desired part of the curve. The plate current surge can be made to operate a relay and stop the action of the motor unit. The relay can be adjusted so that it will operate only on a surge of a certain value, say 1 milliampere, above the average value.

It would be possible to adjust the grid voltage of the last low-frequency valve of the receiver so as to cause it to act at the lower bend of its curve, and use the plate current surge to operate a relay. This would not be desirable, however, since it would mean distortion in the output. An amplifier valve should work on the straight portion of its curve. We may solve this difficulty by connecting another valve, after the manner of a vacuum valve voltmeter, across the secondary of the last low-frequency transformer. This we shall call the tuner valve. As the tuner valve is not in the receiving cir-

QUICK, EASY CHANGES TO A.C. WITH NA-ALD ADAPTERS

MADE IN THE LARGEST SOCKET MOULDINC FACTORY IN THE WORLD

Na-Ald Offers You—

Best Engineering Design

Patented Features

Flawless Workmanship

Perfect Contact

At Lowest Retail Prices

NO CHANGES in the sockets, wiring or batteries of present sets are necessary for your use of the UX, CX or other similar power tubes, and the new AC valves. Na-Ald Adapters and Connectoralds will hold the new tubes in your present style sockets. The new power tubes require extra "B" and "C" batteries for proper operation. Na-Ald Connectoralds provide cables for connecting the extra batteries direct to the tube, without affecting the rest of the set.

To use the new power tubes with Na-Ald Connectoralds, just insert the tube in the Connectorald, attach the leads of the connectorald to the extra "B" and "C" batteries, and put the tube and Connectorald into the set.

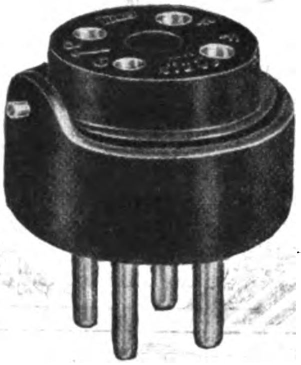
Na-Ald Connectorald are supplied for every desired combination. These devices are especially designed to give most efficient operation for particular conditions. Like tubes, they are delicate apparatus, and must be carefully handled.

NA-ALD SILENCER SOCKET, with its many patented features, is unequalled. Its contact is a constant pressure triple phosphor bronze of N shape, presenting a parallel face to the entire length of the tube prong. This pressure is firm, removing corrosion from tube prongs and making positive, low resistance contact.

Insert a tube in one of these sockets, noting that it brightens the full length of the tube prong, although it goes in readily and is removed easily from the socket.

Examine a cross section and you will see that a firm, constant pressure is exerted all along this brightened surface. Being sure of perfect contact, regardless of how much used or how irregular the tube prongs are—the contact shapes itself in a resilient bow, like an automobile spring.

The socket is moulded so that no amount of abuse, twisting, or tugging can injure these flexible contact springs that allow the tube to move upward, downward, laterally and pivotly. Because of this resiliency, all possible vibrations are instantly absorbed and not transmitted to the tube.



Once again, the contact counts in making for perfect reception, in that Na-Ald Silencer Sockets can fit neatly and snugly to panels and with four small holes in the panel provide extension tabs for soldering leads. The soldering tabs are the same piece of metal that contacts with the tube prong, this direct connector avoiding loose or noisy connections.

For above panel, the binding post connections can be used or the solder tabs can be brought out below the base. Na-Ald Silencer Socket is made round, so that it can be turned for the most convenient wiring. This also lends itself to mounting on metal panels, holes being punched with clearance for the solder tabs on a round hole of 1" diameter which can be punched and the base bolted to the panel, the round collar protruding.

Na-Ald Silencer Sockets do not depend upon screws to hold the contacts in the button, but are held by a retainer ring so moulded that it becomes an integral part of the socket.

Twisting or pulling cannot injure the socket or contacts. Stops prevent lateral twisting, and an arc-shaped stop retains the proper shape of the contact when pulled upward.

Na-Ald Silencer Sockets are Alden Processed Synthetic mouldings, double cured for the highest electrical insulating qualities, as well as the greatest mechanical strength.

NA-ALD
TRADE MARK
REG. U.S.A. PAT. OFF.

PATENTED
1505329 1546161 1580942
Re16466 Re16467 Re16469
Others Pending

"IT'S THE CONTACT THAT COUNTS"

For detailed information write the manufacturers

ALDEN MANUFACTURING COMPANY ∴ SPRINGFIELD, MASSACHUSETTS

Vital Factors
in attaining
High Quality Reproduction

High quality reproduction depends upon three things: correctly designed coupling units, proper use of amplifier tubes, and an efficient reproducing device.

For over a decade the subject of audio frequency amplification has been extensively studied in the laboratories of the General Radio Company, with particular attention given to the design of coupling units.

As a result of this exhaustive research the General Radio Company has been, and is, the pioneer manufacturer of high quality Audio Transformers, Impedance Couplers, and Speaker Filters.

If the amplifier of your receiver is not bringing out the rich bass notes and the mellow high tones as well as those in the middle register, why not rebuild your amplifier for *Quality Reproduction* with *General Radio* coupling units.

Write for our Series A of amplification booklets describing various amplifier circuits and units.

TYPE 285
AUDIO TRANSFORMERS
Available in two ratios
1 to 3 for 1st stage
Price $6.00
1 to 6 for 2nd stage
Price $6.00

GENERAL RADIO CO
Cambridge
Massachusetts

Harry Alter's RADIO BOOK DECEMBER 1927 Dealers Only

DONT WAIT

You wonder how certain other radio retailers are selling at prices so much lower than yours. Learn why without delay. You will find that as customers of the Harry Alter Co., America's largest jobbers of radio goods, they pay less.

Write for Radio's Greatest
CATALOG Filled with sensational values. We sell only to radio retailers. Send now.

The Harry Alter Co.
1753 Michigan Avenue CHICAGO

MAIL THIS COUPON

The Harry Alter Co.,
1753 Michigan Ave., Chicago
Send at once a copy of your December price guide.

Name..
Address..
City........................State............

No "A" Batteries with These TELEVOCALS

The new Televocal A. C. 226 and 227 Tubes operate direct from A. C. current and require no "A" Battery. Televocal T.C. 112 A and 171 A Power Tubes are made with oxide-coated filaments taking but half the current—¼ amperes as against ½ amperes heretofore.

For best results insist on Televocal Quality Tubes for all purposes. All standard types featured by the exclusive Televocal Support—all fully guaranteed.

TC 201A TELEVOCAL

TELEVOCAL CORP'N,
Televocal Building,
Dept. F-3, 588-12th St.
West New York, N. J.

TELEVOCAL QUALITY TUBES

cuit, we can place its action at the lower bend of its curve without introducing distortion in the receiver output. Figure 3 shows the relation of the tuner valve to the last low-frequency stage.

It is possible to bias the last low-frequency valve and the tuner valve so that the one will act on the bend of its curve and the other on the straight portion. Let E_{b_1} be the voltage of battery B_1, E_{b_2} the voltage of battery B_2, E_s the voltage impressed on the transformer secondary by the two batteries, E_{g_1} the voltage impressed on the grid of the amplifier valve, and E_{g_2} the voltage impressed on the grid of the tuner valve. E_s is common to the two circuits. We have, therefore, the following relations:

$$E_{b_1} = E_{g_1} + E_s$$
$$E_{b_2} = E_{g_2} + E_s$$

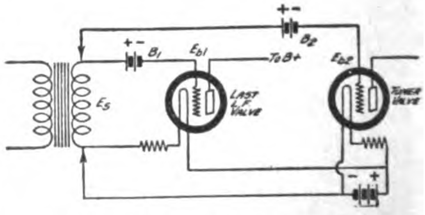
Eliminating E_s, we get

$$E_{b_1} - E_{b_2} = E_{g_1} - E_{g_2}$$

By adjusting the values of E_{b_1} and E_{b_2}, we can make the difference between E_{g_1} and E_{g_2} whatever we choose. Practically, we can connect a milliammeter in the plate circuit of each valve and adjust the grid voltages so that we get a surge in the plate circuit of the tuner valve and no surge in the plate circuit of the amplifier.

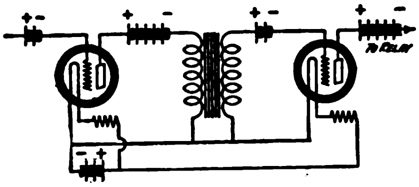
Since the grid current of a valve with a negative bias is practically zero, the tuner valve takes no energy from the receiving circuit. The only effect of the tuner valve on the receiving circuit is that of grid voltage. The grid voltage of the amplifier is not that of its own grid battery, but depends on the voltages of the two batteries, as we have shown. This does not matter, however, since by adjusting the two batteries we can make the grid voltage of the amplifier whatever we choose. We can, therefore, secure our plate current surge without introducing distortion in the output of the receiver. We have the distortion in the output of the tuner valve—which is where we want it.

We can now amplify the output of the tuner valve with another valve and secure a greater plate current surge. This last valve we shall call the tuner



THE TUNER VALVE CIRCUIT

FIGURE 3: *The tuner valve is connected in parallel with the last low-frequency valve; this arrangement prevents distortion in the amplifier output.*



THE HOOK-UP FOR THE TUNER VALVE AND TUNER AMPLIFIER

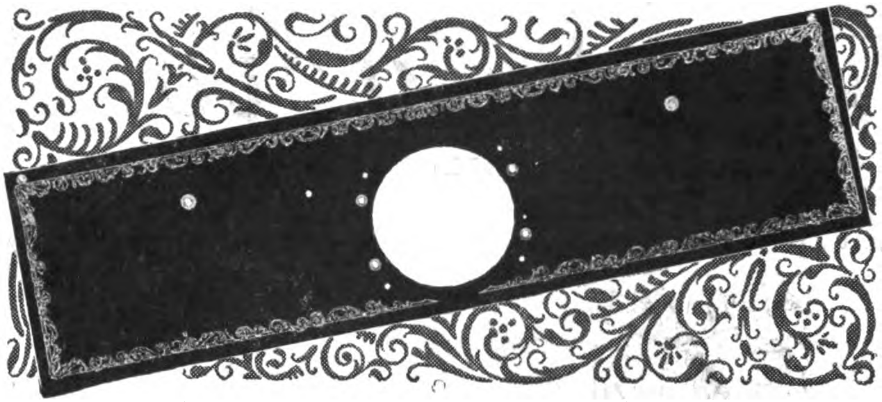
FIGURE 4: *At the left is the tuner valve, connected in the receiver circuit as shown in Figure 3. At the right is the tuner amplifier; its output is connected to the relay, which controls the motor.*

amplifier. There are various methods of connecting the tuner valve and the tuner amplifier. In the receiver shown in Figure 2 a form of inductance coupling is used. This is shown in Figure 4. Using a CX-340 valve as a tuner amplifier, we get a plate current surge of from 1 to 3 milliamperes. By the method described advantage may be taken of both voltage oscillations and plate current surges. The voltage oscillations across the transformer secondary act on the grid of the tuner valve and the plate current surges occur in the tuner circuit, where they do not affect the quality of the receiver output.

In the relay we used 60,000 turns of No. 42 enameled wire, approximately 15,000 ohms, with a core and housing of Norway iron. The armature operates on a surge of about 0.8 milliampere. A surge of this value, or greater, breaks the motor circuit. Since the motor current is approximately 40 milliamperes, there is very little arcing at the contacts. The small amount of arcing that would occur can be practically eliminated by the use of a condenser. A simple form of detent holds the relay armature in position to keep the motor circuit open.

The reset device is simply an electromagnet mounted directly above the relay and connected to the "A" battery of the tuner valve and a push button. The push button may be at the end of a cord as long as desired. When this button is pressed, the magnet lifts the detent, the relay armature closes the motor circuit, and the motor begins to turn the condenser plates at one revolution per minute. When the tuning unit again comes to resonance with signals, the relay breaks the motor circuit. The action is practically instantaneous, since the motor is dead beat. If another station is desired, the button is pressed again and the receiver is tuned to resonance with the next station on the scale that is broadcasting. We have a design for an indicator which can be attached to the set, if desired, and which will indicate at a distance the frequency to which the circuit is tuned.

It can be seen that the automatic tuning control described here does not require the building of a new receiver, but may be added to any receiver with a few easily obtainable parts.



Handsome Panels For These Kit Sets

Formica has prepared handsomely decorated panels for the leading kits of the year, so that home builders can make sets of better appearance. Many of these panels are fully drilled and ready for assembly.

Among the panels offered are Magnaformer, front and sub; world's Record Super Ten, front and sub; Camfield Nine, front and sub; Tyrman, front and sub; Madison-Moore International One Spot for A.C. operation and many others.

Plain Formica panels of any size are also available.

THE FORMICA INSULATION COMPANY,
4641 Spring Grove Avenue, Cincinnati, Ohio.

Leading jobbers everywhere can provide you with Formica products.

Formica has a complete insulating service for manufacturers.

HOW TO BUILD
A SIMPLIFIED A. C. RECEIVER

Here is a booklet for the man who wants to build a simplified receiver that will operate directly from the A. C. lighting circuit, using A. C. heater-type tubes.

The receiver is not only exceptionally easy to build, but it is inexpensive and contains standard parts that may be purchased at any retail store.

The booklet contains complete drawings, specifications and detailed descriptions of every step in the construction of the set.

The book is called HOW TO BUILD A FIVE TUBE A. C. RECEIVER, and it has been prepared by Laurence M. Cockaday, technical editor of POPULAR RADIO.

The price of the booklet is 25c postpaid.

Send all remittances to the

Service Department of POPULAR RADIO
119 West 57th Street, New York, N. Y.

The Braid Slides back

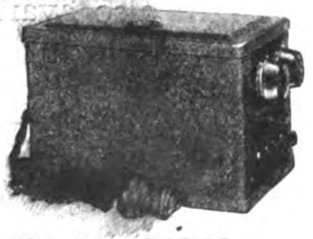
CORWICO
BRAIDITE
HOOK-UP WIRE

Simply push back the insulation on Braidite, make your connection, solder it, and the insulation slides right back into place, leaving no exposed sections of bare wire. Braidite holds its shape permanently after bending, and you cannot scorch or burn it with a soldering iron. Braidite is the easiest and fastest working hook-up wire made, yet it costs less than ordinary hook-up wires. Use Braidite in the next circuit you build. Send 35c for sample carton.

At All Radio Stores
CORNISH WIRE CO.
30 Church St., New York

For every radio purpose there is a Corwico wire that will give longer and better service. Ask your dealer.

MODERN
"B" COMPACT



will give YOU more
Radio Satisfaction

It's the "B" current that carries the radio signal from tube to tube—and to the loudspeaker. Enjoy the finest reproduction by using the quiet, dependable, large capacity Modern "B" Compact. It WILL work on YOUR set. Price $26.50—not including Raytheon Tube.

Modern Elec. Mfg. Co.,
Toledo, Ohio

I enclose 2c stamp for booklet on "How to properly operate my set with a 'B' power unit." PR12

Name..................................
Address...............................
City..................................

WITH THE INVENTORS

CONDUCTED BY WILLIAM G. H. FINCH

THIS *department will keep you in touch with the latest inventions of interest on which patent rights have been granted, and which are significant contributions to radio art.*

A Novel Means for Sound Reproduction

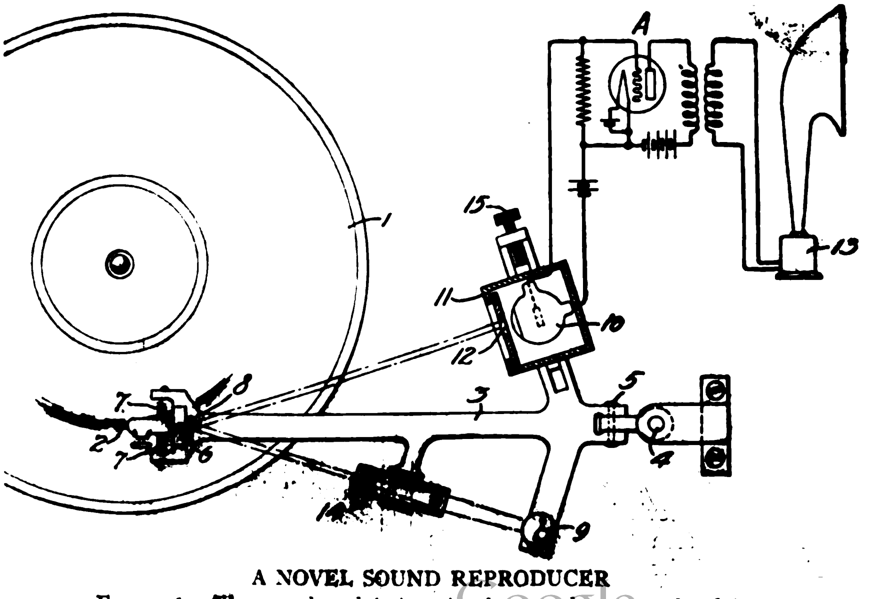
EDWARD B. CRAFT, of Hackensack, N. J., has patented a novel means for reproducing sound. Briefly described, and illustrated in Figure 1, the invention comprises the translation of the sound undulations in a record into variations in light, the translation of the light variations into electrical variations, and the reproduction of sound from the electrical variations after they have been amplified to any desired extent and distributed to any desired point or points.

The light variations may be produced by deflecting a beam of light by a mirror actuated by the usual reproducer needle when the needle passes over the sound record, or vice versa. As the mirror and its actuating mechanism may be made to have extremely small mass, the light variations may represent, to a high degree of accuracy, the recorded undulations.

The light variations produce with high accuracy equivalent electrical variations, and these, in turn, may readily be amplified with negligible distortion to the desired volume and distributed as desired. At the point or points where the sound is to be produced, the usual loudspeaking telephone apparatus may be employed.

Claim 1 reads:

In a sound reproducer, a record having a record groove containing undulations representing sound, an oscillation member mounted so as to be free to oscillate about an axis, means to produce relative movement between said record and said member to bring successive portions of the sound record into operative relation with said member, and to cause oscillations of said member in accordance with the recorded sound undulations, a light-sensitive, electro-responsive element, means to throw a beam of light from said oscillation member to said element, and to vary the illumination of said element by said beam in accordance with the actuation of the member by the sound undulations, means to make the variations in illumination of said element independent of the position of said axis with respect to said record, and means to produce sound from the resultant electric effects.

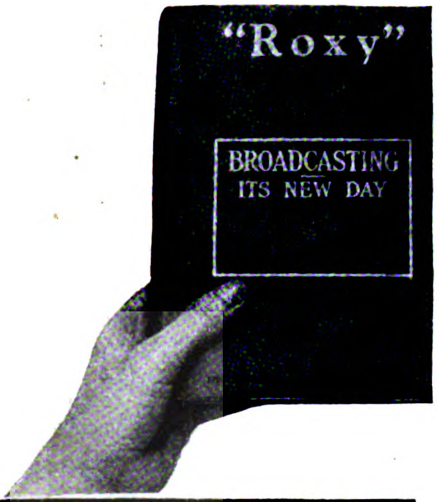


A NOVEL SOUND REPRODUCER

FIGURE 1: *The sound undulations in the record are translated into variations in light and then into electrical variations. These latter are passed through an amplifier and then into the loudspeaker.*

Do You Want A Free Copy of Roxy's Amazing New Radio Book?

Radio's greatest impresario, collaborating with Raymond F. Yates, Editor of POPULAR RADIO, gives his startling private views and predicts revolutionary changes in broadcasting.



Broadcasting, Its New Day

By

S. L. ROTHAFEL (ROXY)

and

RAYMOND F. YATES

Hundreds of thousands of fans who listen to Roxy's weekly concerts have often wondered what he really thought of the big problems of broadcasting and the radio art in general. Now, for the first time, Roxy gives his answer to the big radio questions of the day in the most fascinating, edifying and readable book that has ever been published. In his extremely likable way, Roxy gives his impressions of broadcasting. He not only criticizes, but he suggests startling improvements and needed reforms in the presentation of programs. Roxy tells you what he thinks of radio as it effects the impresario, politics, religion, education and commerce. And he answers, once and for all time, that great question: "Where is broadcasting going, and how will it get there?" You will be surprised and amazed by Roxy's original thoughts on what is today the world's greatest form of entertainment.

The latter portion of the book is given over to a startling prediction of the technical future of the radio art; telling in a simple, readable way of the improvements in short-wave transmission, television, telephotography, receiving sets, tel-mechanics, and the transmission of power through the ether of space. The book is really a liberal education in radio, and treats not only its human side, but its technical side as well.

CONTENTS

- The Radio Receiver of the Future
- Radio Vision
- Radio's Long Arm
- Power Through the Sky
- New Jobs for Radio
- The High-Frequency Age
- Radio and the Wire Telephone
- Can we Talk to Mars?
- Broadcasting: Art or Epidemic?
- Programs and the Impresario
- The Broadcast Drama: A New Art
- The Human Side of Broadcasting
- The New Force in Politics
- The International Aspects of Broadcasting
- What Radio Can do for Education
- Radio and National Sport
- Radio, The Invisible Crusader
- What Can be Done About Interference
- The Wayward Child of Commerce
- The Future of Broadcasting
- Radio and the Future of America's Commerce

HOW TO OBTAIN YOUR COPY FREE

Thousands of people have been willing to pay $2.00 for this book. Now, for the first time, it is available to the readers of POPULAR RADIO who enter their subscription for a period of one year at $3.00 per annum. The book contains 316 pages and is liberally illustrated with heretofore unpublished photographs and simplified diagrams depicting the marvelous technical advancement that has taken place during the past five years. No intelligent person will want to remain ignorant of the great questions that BROADCASTING, ITS NEW DAY, answers.

ACT QUICKLY

Through a special arrangement with the publishers, POPULAR RADIO is able to offer only 2000 copies of this publication. Consequently, this offer can be held open only for a period of thirty days. Your copy is packed and ready for addressing. Act today to make sure that you do not miss this opportunity.

Popular Radio, Inc.
119 West 57th Street
New York, N. Y.

Dear Sirs:
I am enclosing $3.00 for a year's subscription to POPULAR RADIO, and it is understood that you will immediately send me, free of charge, one copy of BROADCASTING, ITS NEW DAY, by S. L. Rothafel and Raymond F. Yates.

Name...

Street...

City...

POPULAR RADIO, Inc.

119 West 57th St. **New York, N. Y.**

YAXLEY
APPROVED RADIO PRODUCTS

Automatic Power Control

FOR CHRISTMAS

The gift of gifts for the set owner.

Makes radio more convenient because it handles the switching of the trickle charger and "B" eliminator automatically. Controls charger or eliminator separately or both in combination.

When the set is turned on, the trickle charger is cut out, and the "B" eliminator is switched in. When the set is turned off, the trickle charger is cut in, and the "B" eliminator is switched off.

Better reception and greater satisfaction are assured. The "A" battery is charging when the set is not in use. It is always ready with plenty of kick when the set is turned on. The "B" eliminator is on only when the set is in use; the tubes last longer, and give better service, and there is no waste of power.

No. 444—Series Type..........$5.00

YAXLEY MFG. CO.

Dept. P, 9 So. Clinton St., Chicago

MAGNAPHON
ELECTRICAL RECORD REPRODUCER

Price $12.50

Will make the old type phonograph or any of the small portables perform like the new Electrical Reproducing Machines costing from $350 to $1,000.

The richness and tone range of the reproduction obtained by means of the MAGNAPHON will prove really amazing.

The deep bass notes, the drum beats, the very high notes, will all issue forth with a life-like mellowness and brilliance.

TWO PATENTED FEATURES

1. A peep-hole in the back of the instrument, making the position of the armature visible.
2. Adjustment screws with which the armature can be recentered if necessary.

EASILY INSTALLED

No adjustments—No removal of old sound box or fishing for correct angle is necessary. Just place the MAGNAPHON alongside the tone arm and insert the plug into the detector socket.

FROM YOUR DEALER OR US

If your dealer cannot supply you and will not get it for you, we will ship you direct on receipt of money order for $12.50.

Tectron Radio Corporation

1270 Broadway New York

Aerovox Condensers are exclusively specified for the

Magnaformer

9-8 Circuit

Selectivity and Stability

The "bypass" condenser plays an important role in every tuned radio frequency amplifier—because it governs the selectivity and stability.—An individual "bypass" condenser should be employed for each radio frequency amplifying tube.

AEROVOX "bypass" condensers, sealed in Bakelite, are particularly effective in radio frequency amplifiers because of their construction.

They are non-inductive—impervious to moisture and are available in all capacities up to 1 mfd. and rated at 200 volts D. C.

AEROVOX

"Built Better"

70 Washington St., Brooklyn, N. Y.

A Simple and Efficient Wavemeter

PAUL T. PLATT, of Norfolk Downs, Mass., describes several improvements in wavemeters, which are intended to be used to help an operator to tune his broadcast receiver to any predetermined wavelength, in patent No. 1,582,780.

The wavemeter that he describes is relatively simple in construction, but is highly efficient in operation, thus making it possible to tune a non-oscillating receiving set with very great accuracy to any desired wavelength within the range of the wavemeter.

The main object of the invention is to provide a radio wavemeter, employing a single three-electrode vacuum tube, which is entirely silent itself, in operation, but which oscillates at audio frequencies, and causes to be radiated a radio-frequency wave. This wave is modulated by an audio-frequency wave that may be picked up on a non-oscillating receiver, and that produces a tone that is pure in character and that is very easy to tune in sharply.

Figure 2 shows a device that embodies the invention. It comprises an oscillating three-electrode vacuum tube and means to tune the associated circuit to any desired wavelength within the range of the instrument. The associated circuit is of such a design that a radio-frequency wave is produced and radiated.

Audio-frequency oscillations are produced by reason of the fact that the circuit action causes the grid of the vacuum tube to choke periodically. This blocking action causes periodic interruptions in the radio-frequency oscillations, which are inaudible in themselves, and divides them into groups of oscillations that occur at much lower and audible frequencies. This causes to be radiated a radio-frequency signal of low power, modulated by an audio frequency, which may be picked up on a non-oscillating receiving set.

Figure 2 is a wiring diagram that illustrates the principle of the invention.

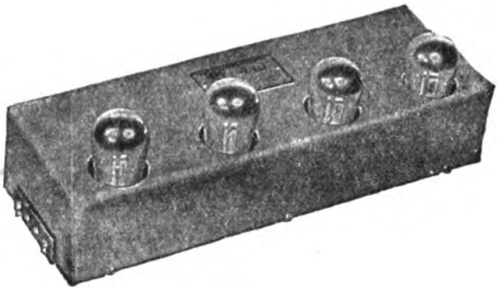
Figure 3 shows a part of a calibration sheet.

In the diagram, 1, 2 and 3 indicate the filament, grid and plate, respectively, of a three-electrode vacuum tube. The filament is connected to the low voltage or "A" battery, 4, through a filament circuit, 5, the latter having the usual rheostat, 7.

The high-voltage or "B" battery is indicated at 8. This is connected to the plate through the plate circuit, 9, as usual. The grid circuit is shown at 10.

The theory of operation is as follows. A large, double, plate winding, specially interconnected, is close-coupled in fixed relation to the tuned grid inductance. With the filament circuit closed and a moderately high "B" battery potential applied to the plate, there is a tendency

The Finest Long Wave Amplifier Ever Made



WITH a greater degree of selectivity, with a greater amplification factor—the 440 Jewelers Time Signal Amplifier offers possibilities never before realized in long wave amplifier construction. It is more accurate—with a finer degree of calibration—than any long wave amplifier that may be built from standard parts today. It's so good that it simply can't be beaten—with any combination of individual parts or anything else. It is housed in a copper and brass catacomb which completely and individually shields the three radio frequency and detector stages. The 440 Time Signal Amplifier is tremendously popular already, for thousands have been sold this season, simply because it's the best long wave amplifier ever developed. It is tuned exactly to 112 K. C., the 2677 meter wavelength of the Naval Observatory station at Arlington (NAA). Price $35.00.

THE LC-28 UNIPAC

The LC-28 Unipac is Mr. Cockaday's own selection—the ideal low frequency amplifier and power supply for the LC-28 receiver; and the two together provide a perfectly coordinated tone and power combination.

The LC-28 Unipac is a two-stage light socket operated power amplifier using one CX-326 A. C. tube in the first stage, and a CX-310 super power amplifier in the second stage. A combination of the new, specially developed, S-M audio and 241 output transformers gives perfect tone and uniform amplification to all frequencies from below 100 to above 5000 cycles where used for phonograph or radio amplification. The CX-310 tube, with a full 425 volts on its plate, results in beautiful rounded tone with ample volume, while the power supply, furnishing all ABC power to the Unipac amplifier, also supplies B potential to any receiver at 45 and 90 volts, with automatic glow tube voltage regulation.

Like all other S-M Unipacs (push-pull 171 or 210 types) the LC-28 is housed in a beautiful brown crystal-finished steel case which protects all parts and safely encloses all tubes and high voltages—for over 475 volts is delivered by the full wave rectifier using two CX-316B or CX-381 tubes.

Though especially designed for Mr. Cockaday's new set, the LC-28 Unipac will operate as an entire two-stage power audio amplifier and B power supply with any receiver at all. Used to replace the entire audio system of older receivers, it will also eliminate all B batteries and provide a quality of reproduction which is a positive revelation in tonal beauty.

The LC-28 Unipac may be procured from any good dealer as a kit ready to assemble, priced at $81.25, or individual parts may be procured if desired.

There are many other Unipac models—they may be built in many different ways for any sort of power and audio combinations and as phonograph amplifiers. Ask us to send you the complete Unipac literature.

We Could Charge More—But a *Better* Transformer Can't Be Made

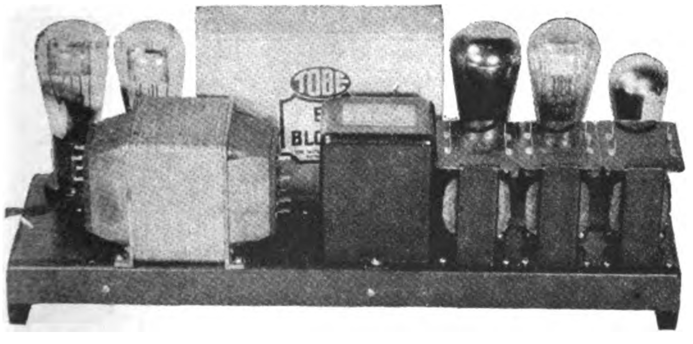
That's a cold statement about the S-M 220 audio transformer, but it takes steel and copper to make the best transformer. The size and weight of the S-M core—the countless turns of wire—these are the things that produce real transformer quality. And where will you find a heavier or higher grade silicon steel core—where will you find more copper than in the S-M 220? The 220 has from 25 to 50 per cent more steel and copper in its construction than any other transformer on the market. We could charge from 25 to 50 per cent more for them than we do, but at no price can you get a better transformer. Do you wonder why it's sold on an unconditional guarantee to give you better tone quality than any other audio amplifying unit available? The 220 audio is $8.00, and the 221 output is $7.50. Of unapproachable quality, they are *priced* low, but not merely made to sell at a low price.

We can't make the 220's cheaper, but if you desire a transformer somewhat lower in price, taking up a little less room, and with a little less core and wire, the new 240 audio and 241 output transformers are larger than practically all other transformers, and are far superior to items at twice their price. They have the same general characteristics as the famous 220's and 221's, but provide slightly less accentuation of frequencies below 80 cycles. They have the same 5000 cycle cut-off for which 220's are famous, eliminating many of the objectionable whistles and heterodyne squeals. The 240 audio sells for $6.00 and the 241 output is $5.00. Hard to beat at any price, it is impossible to equal them at their prices.

S-M audios have outsold all other transformers. They are specified for more prominent circuits than all others. The reason is obvious.

They are better.

That's all.



SILVER-MARSHALL, INC.
844A West Jackson Blvd., Chicago, U.S.A.

Silver-Marshall, Inc.
844A West Jackson Blvd., Chicago.

Please send me all data on the Unipacs, Improved Shielded Six, new transformers, ABC power units, etc. Enclosed is 10c to cover postage.

Name..

Address..

NO RADIO UNIT IS ANY BETTER THAN ITS COIL

DUDLO

The performance of Battery Eliminators, Audio Transformers, Loud Speakers, and all other Radio Units is in exact ratio to the efficiency of their windings. **It's the Coil that does the work!**

Nearly all leaders in radio and radio parts use Dudlo Coils because they know their superiority.

DUDLO

Dudlo Manufacturing Corporation
FORT WAYNE, INDIANA

HARRY ALTER'S NEW LOWER PRICES WILL AMAZE YOU!

Again Harry Alter challenges all competition by smashing prices that were already the lowest known in radio. Staggering values in sets and parts of standard quality. Get my new December catalog. Write for it NOW. We sell to retailers only.

The Harry Alter Co.

1751 Michigan Avenue CHICAGO

MAIL THIS COUPON

The Harry Alter Co.,
1751 Michigan Ave., Chicago

Send at once a copy of your December price guide.

Name..

Address..

City.................................State.............

to violent radio-frequency oscillations.

However, the grid condenser is bridged by a very high resistance grid-leak, of such high resistance that the grid of the vacuum tube chokes periodically, thus dividing the high-frequency pulsations that are generated, into groups which occur at audio frequency. This results in the radiation of an audio-frequency signal, which is tuned to the desired wavelength by the variable condenser shunting the grid inductance.

The frequency of the audio wave may be varied, within moderate limits, by the adjustment of the filament rheostat. Audio-frequency variations, of this sort, have no effect on the wavelength calibrations.

On a given rheostat setting, there will be very little variation in audio frequency at the opposite ends of the wavelength scale of the wavemeter. This is due to the constants and the arrangement of the grid and plate circuits, which are such that audio pulsations are freely produced throughout the wavelength range of the instrument.

The frequency of the received audible note corresponds to the frequency of the grid blocking action in the wavemeter. This action changes an inaudible oscillation of, say, 1,000,000 cycles, to an audible one of approximately 100 cycles, or higher as desired.

In Figure 2, the large, double, plate winding is shown at 11 and the tuned grid inductance with which this plate winding is close coupled is indicated at 12.

The variable condenser by which the tuning is effected is indicated at 13. This condenser is operated by any usual control.

The usual grid condenser in the grid circuit is shown at 21 and 14 is the high resistance grid-leak which bridges this condenser.

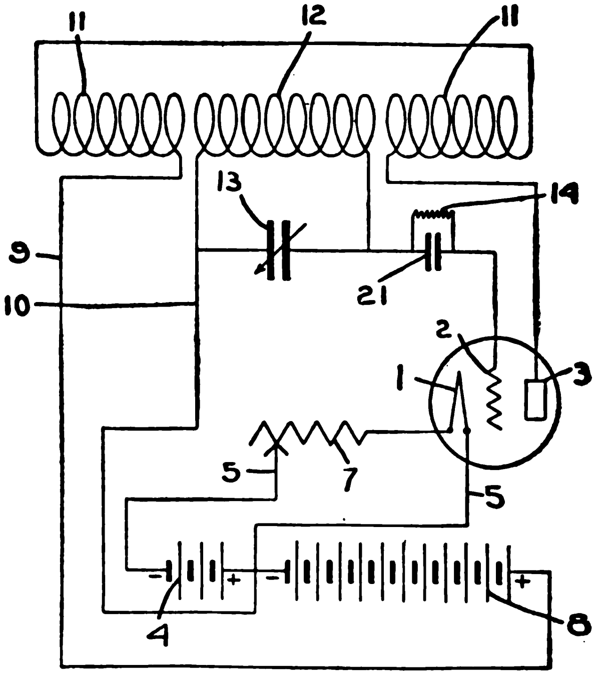
One use for which this wavemeter is intended to be used is to assist a person to tune his receiving set exactly to any predetermined wavelength.

In order to use the wavemeter it is necessary to have it calibrated and to employ a calibration curve. The calibration of the instrument consists in determining the wavelength values corresponding to the various settings of the variable condenser. This information must be obtained from a standard source before the wavemeter can be used.

Figure 3 illustrates a partial list of hypothetical calibration adjustments. The figures under the columns labeled "Dial" indicate the reading by dial divisions for the variable condenser; the figures in the column labeled "Meters" indicate the corresponding wavelength.

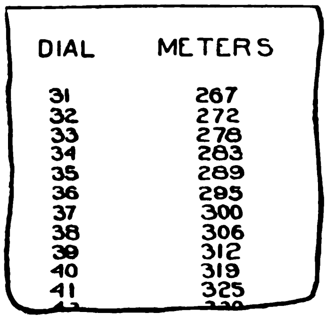
According to this calibration, if the variable condenser is set at 37 the vacuum tube produces radio-frequency oscillations tuned to a 300-meter wavelength; if the variable condenser is set at 38, the wavelength of the emitted signal will be 306 meters. A setting of the variable condenser at 39 will cause an audio radiation tuned to 312 meters.

Assuming that the operator desires to set his receiving set for the reception of a broadcast on a 306-meter wavelength, he should adjust the variable condenser of the wavemeter to indicate "38." When the filament circuit is closed through the rheostat the vacuum tube of the wavemeter will cause radio oscillations to be radiated tuned to 306-meter wavelength.



THE CIRCUIT DIAGRAM OF THE WAVEMETER

FIGURE 2: *This simple and efficient wavemeter may be used to tune a receiving set to a predetermined wavelength or to find the wavelength of any received signal.*



DIAL	METERS
31	267
32	272
33	278
34	283
35	289
36	295
37	300
38	306
39	312
40	319
41	325

A CALIBRATION SHEET

FIGURE 3: *The wavemeter must be carefully calibrated before it is ready for use.*

The grid-choking action of the tube produces a radio-frequency wave tuned to 306 meters which is modulated by audio frequency and may be readily picked up by the non-oscillating receiver.

The wavemeter should be placed from 1 to 10 feet away, according to the sensitivity of the receiver.

After the wavemeter has been adjusted for any particular wavelength and set in operation, the operator should tune his receiving set to the wavemeter. This is done by adjusting the controls of the receiving set until the wavemeter signal comes in clear and strong, and at maximum intensity.

The operator then knows that his set is tuned exactly for the reception of radio transmission on a wavelength of 306 meters. The wavemeter is then shut off and the receiving set is in condition to receive any broadcast which may be coming in on the 306-meter wavelength.

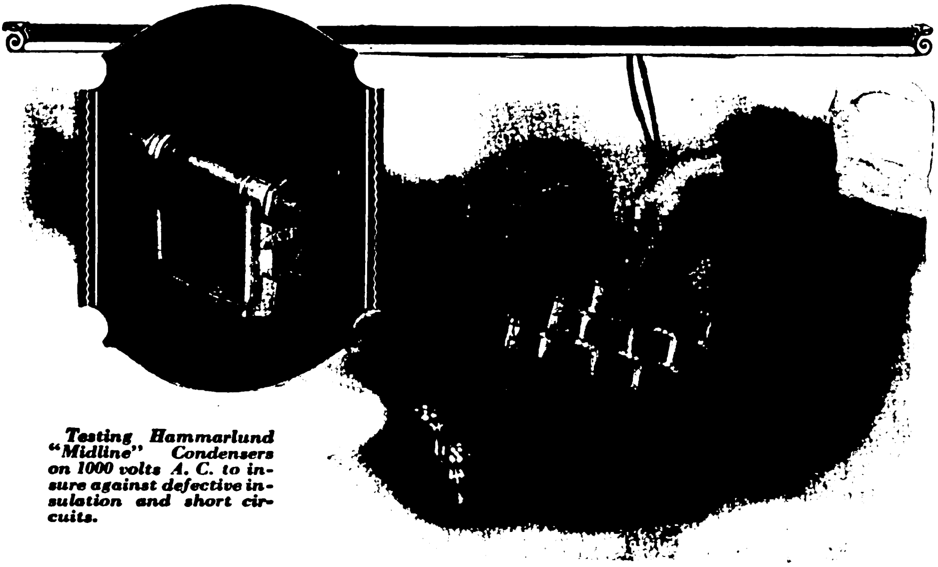
The wavemeter may also be used to ascertain the wavelength of any broadcast which has been picked up by the receiving set.

In this case, the wavemeter should be put in operation and its variable condenser rotated until the audio-frequency wave generated by the wavemeter is distinctly heard, together with the broadcast, after which a reading is taken of the wavemeter's condenser setting.

This method will give accuracy to within a meter or two. If greater accuracy is desired, the filament rheostat of the wavemeter may be adjusted so that straight radio-frequency oscillations are produced, after which a zero beat adjustment on the broadcast station's carrier wave can be made.

Claim 1 reads:

A radio wavemeter, said wavemeter comprising a single oscillating vacuum tube with filament, grid and plate circuits therefore, a two-section winding in the plate circuit, said sections being connected at their outer ends, a tuned inductance in the grid circuit situated between the inner ends of the two sections of the winding in the plate circuit, a grid condenser in the grid circuit and a high-resistance grid-leak bridging said grid condenser, whereby a periodic grid-choking action is produced which causes the radio-frequency oscillations to be broken into groups occurring at audio frequency over a wavelength band of at least 188 to 555 meters.



Testing Hammarlund "Midline" Condensers on 1000 volts A. C. to insure against defective insulation and short circuits.

Hammarlund *Precision* Means Your *Protection*

THE word "Precision" as applied to Hammarlund Condensers, Coils, Chokes and Shields means precisely what it says.

It means soundness of design, accuracy of manufacture, fineness of finish and scientific testing. Precision has given Hammarlund Products undisputed leadership in their respective fields.

From the very first, Hammarlund has stood for high quality and Hammarlund has never deviated from that principle.

But you pay no premium for Hammarlund reputation. Hammarlund Products are standard-priced. You can pay far more and get far less than Hammarlund Products give you.

Write for the Hammarlund descriptive folder before planning your new receiver

HAMMARLUND MANUFACTURING COMPANY
424-438 W. 33rd Street, New York

More than a score of radio designers officially specify Hammarlund Precision Products for their latest circuits.

For Better Radio
Hammarlund
PRECISION
PRODUCTS

Dealer inquiries invited concerning several new and appealing Hammarlund developments, having a wide sales demand.

YOUR OWN BUSINESS
Without Capital

Right now, there is an opportunity in your locality to profitably devote your spare time or all your time to a pleasant, easy and profitable business—one that does not require any training or capital.

The publishers of POPULAR RADIO offer you an opportunity to become their local representative to take care of expiring subscriptions and new subscriptions for POPULAR RADIO and one other popular magazine that they publish.

SALARY AND COMMISSION

All material will be furnished you free of charge and you will be paid an attractive commission and salary. Mail coupon for full particulars.

POPULAR RADIO, Dept. 46,
119 W. 57th St., New York City.

Send me full particulars regarding your salary and commission offer to local representatives.

Name..............................

Address..............................

....

2-DIAL KARAS EQUAMATIC
USE
KARAS
PARTS
KNICKERBOCKER "4"

Knickerbocker 4
THE WONDER SET
2-Dial Karas Equamatic
5 Tube Receiver

THESE two famous receivers, as well as scores of other well-known sets, owe no small part of their marvelous performance to the use of Karas Parts. Karas Condensers, Transformers, Filters, Coils and Dials are the perfected products of a factory which has been building precision electrical apparatus for more than a third of a century. Write today for complete catalog of all Karas Parts, and details of the Knickerbocker 4 and the 2-Dial Karas Equamatic.

KARAS ELECTRIC CO.
4029-L North Rockwell Street
CHICAGO
Manufacturers of Precision Electrical Apparatus for More Than a Third of a Century

Corbett Cabinets

That Add to the Coziness of Any Home

Model "C" Walnut Only

The ultimate in elaborate and attractive radio furniture is offered in our model "C." It is an adaptation of the old Italian Chests, being designed and decorated in the spirit of the Renaissance period.

The back is grooved into place, and no nails or screws are used on any exposed surface. The front is grooved for 3/16" panel, the top rail being removable. Fancy folding top stay and piano hinge are applied.

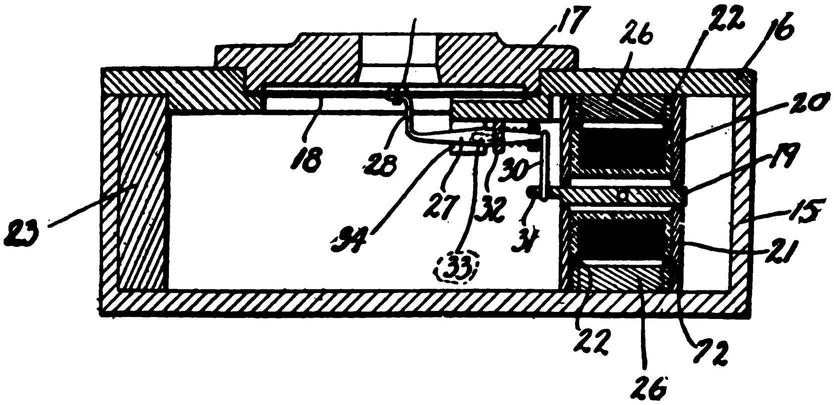
PRICE LIST
MODEL "C" CABINETS
Walnut Only

Panel Size	10 in. deep	12 in. deep	Weight	Mounting Boards
7x18	15.50	17.00	26	.90
7x21	17.00	18.50	28	1.00
7x24	19.00	20.50	31	1.10
7x26	20.50	22.00	34	1.20
7x28	.....	23.00	37	1.30
7x30	.....	24.00	40	1.40

LC-28 CABINETS
Mahogany $18.00 Walnut $18.00

In stock ready for shipment
Write for illustrated folder

Corbett Cabinet Manufacturing Company
ST. MARYS, PENN.



AN IMPROVED TYPE OF LOUDSPEAKER CONSTRUCTION

FIGURE 4: *Instead of a rigid connection between the diaphragm, 18, and the loudspeaker armature, 19, the inventor uses the lever system shown, which has a semi-rigid pivot. The purpose of this arrangement is to prevent unnecessary wear on the system.*

New Developments in Loudspeaker Construction

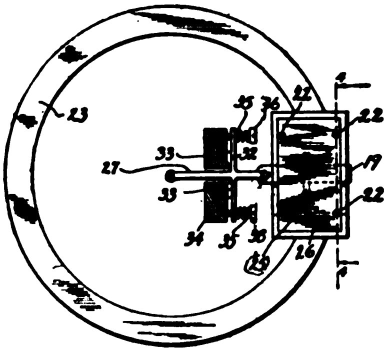
SEVERAL improvements in the construction of loudspeakers that are used with radio receivers are given in patent No. 1,571,452 which was recently issued to John J. Low. These improvements are illustrated in Figures 4 and 5.

In radio loudspeakers there are generally two factors that hurt their commercial success.

The first of these is the fact that countercurrents are set up in the solenoid because of the magnetic lines of force that emanate from the permanent magnet and that traverse the solenoid winding. These countercurrents affect the armature to the extent that they produce that familiar and objectionable roaring sound at the diaphragm which so injures the clarity of the sound that is produced.

The second factor is the rigid connection between the diaphragm and armature which generally causes an early disintegration of the mica diaphragm, and which also prevents the control of the volume of sound that is produced.

The purpose of this invention is to provide a loudspeaker construction that will eliminate these undesirable features.



A TOP VIEW OF THE LOW LOUDSPEAKER

FIGURE 5: *The pole faces of the permanent magnet, 23, are shaped in such a manner that the lines of force between them do not cut the winding of the electro-magnet.*

A Novel Crystal Detector

T. E. ARUNDEL, of Omaha, Nebraska, was recently granted patent No. 1,569,446 for a new type of crystal detector.

This invention aims to provide a detector that is of a permanent nature, but in which the crystal may be replaced.

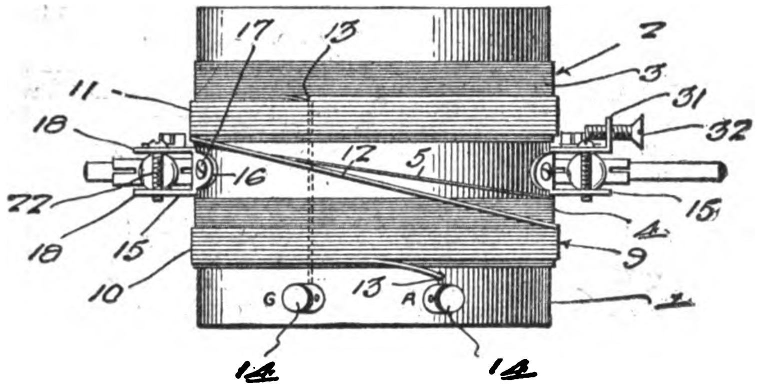
At the same time it is hoped to obtain by means of this detector a clearness and intensity of reception which will be even greater than is given by the most efficient crystal receivers at present.

Another feature of this invention is a provision for a variable or adjustable contact surface that comprises an infinitesimal number of contact or detector points that are so relatively positioned that only a slight adjustment between the surfaces is necessary to renew or change the relation between the contacts. In this way a few loud or clear points of contact are insured at all adjustments.

A further object of the invention is to provide a detector that has complemental surfaces which are adapted to be brought into proper contacting positions. These surfaces may have abrasions or roughened surfaces arranged promiscuously upon them so that variable and unpredetermined contacts may be made during the relative movements of the surfaces. This will always insure new combinations of contacts.

In addition, a provision is made for a means of renewing or increasing these contact surfaces so that, when they wear or grind down, they may be renewed. This is accomplished by a relative adjustment of the surfaces that are incident to the abrading action.

This invention also provides a substance of an abrasive or granular nature that is pocketed between the relatively movable surfaces of the detector. This is adapted to cut and abrade the surfaces irregularly so as to cause the irregular projections or depressions that are essential to the formation of the contact points in the detector



A THREE-CIRCUIT TUNING COIL

FIGURE 6: *The secondary is divided by the "tickler" shaft into sections 3 and 4; sections 10 and 11 of the primary are wound over the former.*

An Improved Type of Inductance Coil

IMPROVEMENTS in inductance coils are the basis for patent No. 1,567,600 which was recently granted to Patrick J. Kelly, of Philadelphia, and which is illustrated in Figures 6 and 7.

An interesting feature of the invention is a provision for an inductance that has a plurality of coils that are arranged for cooperation. They are constructed in predetermined proportions that are adapted to be interposed in the antenna, plate, grid and filament circuits of a tube receiver.

The coils cooperate to transform and amplify the signals that are received in the antenna circuit, thus increasing the distance reception range of the set and increasing the amplification of the signals in the circuit.

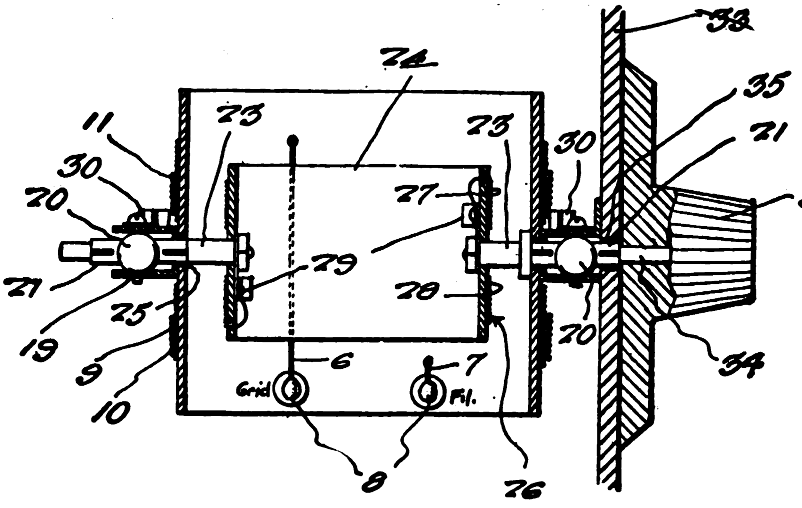
Another object of the invention is to provide an inductance coil that comprises a stationary tube upon which is wound a secondary winding. The winding is arranged in spaced sections of equal inductive value on the tube. Superposed on the secondary is a primary that is formed of spaced coil sections of predetermined inductance value equal in each section, and that has a predetermined relation with the sections of the secondary (as shown in Figure 6).

The primary is arranged in a special relation to the secondary coil section as it is connected in the antenna circuit and the secondary is connected in the filament and grid circuits of the radio receiver while a movable coil member is rotatably mounted within the tube, on an axis extending between the sections of the secondary coil.

This movable coil is also formed in spaced sections of equal inductive value and it is adapted for connection in the plate circuit of the receiving set, in order to produce a cooperation with the stationary primary and secondary coils so that signals received in the primary circuit will be transformed and amplified in the secondary coil and in the movable coil. In this way a maximum range of reception in the set and amplification in the receiving circuit may be obtained.

Claim 1 reads:

> An inductance coil for radio receiving apparatus comprising a secondary stationary inductance, formed in a pair of separated sections mounted in axial alignment, a primary winding formed in a pair of sections superposed on the sections of the secondary winding in concentric relation, and a movable inductance coil of smaller size than the first mentioned coil rotatable on an axis extending between sections of the coil.



A CROSS SECTION OF THE TUNING COIL

FIGURE 7: *The position of the rotatable "tickler" or plate coil is shown here. Its winding is also divided into two equal sections, 27 and 28.*

Perfect Radio Parts *for* Discriminating Set Builders

***The* BRADLEYUNIT-A**

is a fixed resistor that is molded and heat-treated under high pressure. It does not rely on glass or hermetic sealing for protection against moisture. Is not affected by temperature, moisture, or age. The ideal fixed resistor for B-eliminator hookups.

***The* BRADLEYOHM-E**

is standard equipment for accurate plate voltage control on many leading B-eliminators. Scientifically-treated discs in the Bradleyohm-E provide noiseless, stepless plate voltage control.

***The* BRADLEYLEAK**

A variable grid leak that provides perfect grid leak adjustment, thereby providing the best possible results with any tube.

***The* BRADLEYSTAT**

The ideal filament control. Gives noiseless, stepless control for all tubes. Can be easily installed in place of wire wound rheostats.

When you build a set or B-eliminator, demand Allen-Bradley Perfect Radio Resistors to secure best results

Allen-Bradley Co.
Electric Controlling Apparatus
276 Greenfield Ave. A-B Milwaukee, Wis.

Micrometric Control for Your Set

The Volume Control Clarostat now makes its bow

It's a little fellow, compact, good looking, inexpensive, handy—just the thing for applying adjustable yet positive resistance in various parts of the set. And it's a genuine Clarostat through and through.

Control

loud speaker volume; match transformers for best tone quality; tune loud speaker to your taste; get maximum sensitivity out of r. f. and detector tubes; control regeneration micrometrically, especially on short waves—all with Volume Control Clarostat. And there are many other ways now becoming popular for improving your set with micrometric resistance control.

The Volume Control Clarostat has resistance range of practically zero to 500,000 ohms in several turns of knob. Ample current-carrying capacity for all receiver applications. Holds its resistance adjustment. Silent in operation. Screw terminals. One hole mounting. And only $1.50.

VOLUME CONTROL CLAROSTAT

Of course you must continue to use the larger Standard Clarostat for B-eliminator applications, and the giant Power Clarostat for A-B-C power units, line voltage control, and power amplifiers, as heretofore.

There's a Clarostat for every purpose. Make sure, however, you get a genuine Clarostat—look for distinctive green box and name CLAROSTAT stamped on nickel shell. Don't be fooled.

Ask your dealer for literature on Clarostats and how to improve your radio set. Or write us direct:

American Mechanical Laboratories, Inc.
Specialists in Variable Resistors
285 North 6th St., Brooklyn, N. Y.

A Reliable Short-Wave Transmitter

PATENT No. 1,585,244, issued to William H. Hoffman, of Madison, Wis., describes an invention which has to do with the generation of high-frequency oscillations for radio transmission. It is directed more particularly to an improved vacuum-tube oscillator which is especially well adapted for use in generating extremely high frequencies, or, what amounts to the same thing, for use as a short-wave transmitter oscillator.

Probably the greatest problem which has had to be contended with in the efforts which have been made to develop short-wave transmission, is that of maintaining a sufficiently high degree of stability. When such extremely high frequencies are generated, slight disturbances, which would not have any noticeable effect at lower frequencies, are often serious enough to vary the frequency to such an extent as to make reception very difficult, if not impossible.

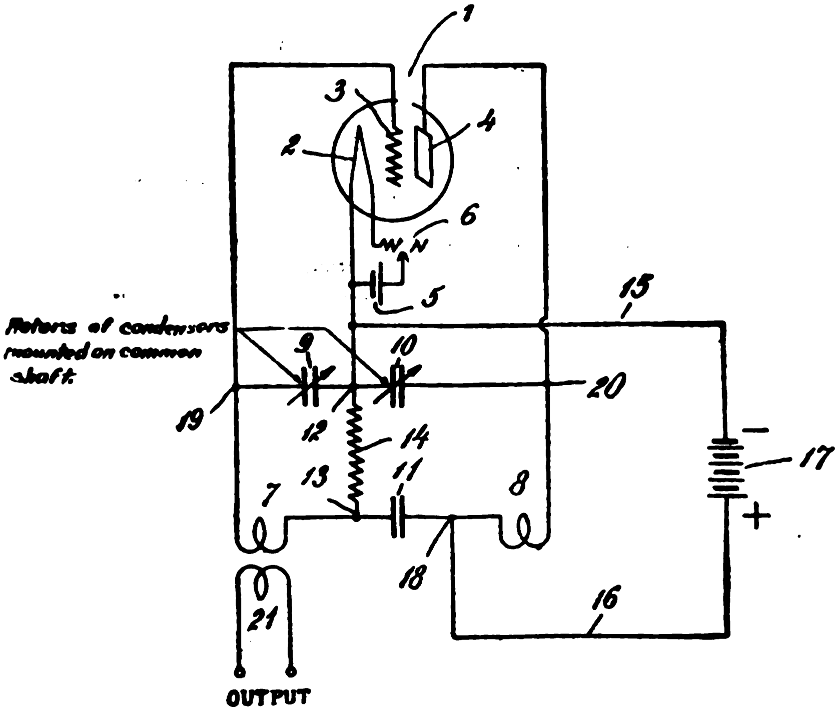
Tireless efforts have been made by those interested in the development of short-wave transmission toward overcoming this lack of stability. But it does not appear that a great deal of progress has so far been made in that direction.

The present invention is the result of careful analysis of the probable causes of instability carried on concurrently with cut and try experiments. The experiments were started at about 600 meters and the wavelengths gradually reduced until 3 meters was reached. Observations were made at each step and any tendency toward instability noted and efforts made to analyze the causes of such instability. The ultimate outcome was that when the wavelength of 3 meters was reached a circuit had been developed which was just as reliable and stable at that wavelength as at the longer waves.

In the high-frequency generator thus developed there is a high-frequency oscillatory circuit consisting of inductances and capacities, to different points of which the respective electrodes of the vacuum tubes are connected. The high-frequency oscillatory circuit contains capacity and inductance elements which are so proportioned, with respect to each other, that it constitutes an arrangement equivalent to a high-frequency bridge.

Across two equipotential points of this bridge there is connected a high-resistance element, forming a leakage path for the grid; the direct current supply for the plate circuit is also connected across the same or equivalent points. By virtue of this arrangement the direct current source and leads are kept out of the high-frequency circuit and it appears that the extraordinary stability of the generator is largely due to this fact.

Tuning is preferably effected by means of a pair of variable condensers, the rotatable plates of which are mounted on a common shaft so that their capacities may be increased and decreased simultaneously. These condensers each form one arm of a high-frequency bridge. They are usually so designed that they have substantially equal capacities for each setting, although this is not essential; it is only necessary that they be so proportioned that the bridge is at least approximately balanced for all settings of the condensers.



THE CIRCUIT DIAGRAM OF THE TRANSMITTER

FIGURE 8: *This short-wave transmitter, developed by Mr. William H Hoffman, is said to be able to transmit on a wavelength as low as three meters with as much stability and reliability as on the longer wavelengths.*

The circuit diagram, shown in Figure 8, illustrates the exact arrangement with which these unusual results were obtained but it should be realized that some little modification is possible without detriment to the efficiency and stability of the system.

In Figure 8, 1 is a three-electrode vacuum tube comprising a cathode or filament, 2, a control electrode or grid, 3, and an anode or plate, 4. A filament heating battery, 5, together with a filament control resistance, 6, are provided. For low-power purposes the tube may be of the type commonly used in radio receiving apparatus (UV-201-a, for example).

It has been commonly supposed that, in order to generate such high frequencies, as that corresponding, for example, with a five-meter wavelength, it was necessary to use a tube in which the lead-in wires for the plate, grid and filament were widely separated. It has been found, however, that with the circuit here shown it is not necessary to provide a tube of special construction, but that, on the contrary, an ordinary tube of the type referred to above will give equally good results. No doubt with increasing frequencies it would be desirable, if not necessary, to provide a tube in which the lead-in wires are more widely separated so as to reduce the capacity between them.

The oscillatory circuit, which is the main factor in determining the frequency at which the generator will operate, comprises two inductance coils, 7 and 8, two variable condensers, 9 and 10, and a fixed condenser, 11, of large capacity. Condensers 9 and 10 are variable and their movable plates are mounted on a common shaft, so that their capacities may be varied simultaneously and equally or proportionately.

The high-frequency oscillatory circuit forms a bridge, the four arms of which contain respectively, inductance 7, inductance 8, condenser 9 and condenser 10. The fixed condenser, 11, is also included in that arm of the bridge including inductance 8. The arrangement is preferably such that the two arms of the bridge containing the inductances 7 and 8, respectively, are of equal reactance.

If the condenser, 11, is large, the reactance due to it is very small at the high frequency dealt with, so that even if the two inductances, 7 and 8, are equal there is practically no unbalance due to condenser 11. This condenser may be of the order of .003 microfarads for a transmitter designed to operate in the neighborhood of 5 meters or less.

Assuming that the bridge is balanced, the points 12 and 13 are of equal or substantially equal potential.

A high resistance, 14, of the order of, say, 5,000 ohms is connected across equipotential points. The leads, 15

Aluminum Company of America manufacture the L. C. 28 Chassis Sub-panel and the "Junior" Aluminum Box Shields specified for Cockaday's L. C. 28.

ALUMINUM SHIELDING

in the newest sets

RECENT radio developments demonstrate that Aluminum has been more widely adopted for shielding by the leading manufacturers than ever before.

This metal is especially effective as a shield at radio frequencies and has been accepted as standard by many of the foremost radio engineers.

Aluminum has countless applications in radio receiving sets. It is rapidly becoming a mark of quality quickly recognized by the layman.

"Aluminum for Radio"—a booklet explaining these manifold uses—will be mailed to you upon request.

ALUMINUM

Aluminum Company of America

2461 Oliver Building, Pittsburgh, Pa.

Offices in 18 Principal American Cities

"ALUMINUM IN EVERY COMMERCIAL FORM"

RADIO PROBLEMS SOLVED

It is possible that your individual problem has been covered in an issue of POPULAR RADIO, and so as an aid to you we endeavor to keep a supply of back numbers in stock. The condensed index below gives a few of the subjects that have appeared recently; look this list over and if the information you want is covered, we will be pleased to supply back numbers at 35c a copy.

October, 1926
—How to Build the New LC-27 Receiver.
—The Radio Road Hog.
—POPULAR RADIO Circuits.
—Sets That Earn Incomes.
—Inside Information on New Radio Receivers.
—Why Signals Fade.

November, 1926
—How to Build the LC-Senior Power-Pack.
—Waves and Wavelengths.
—POPULAR RADIO Circuits.
—How to Select Your Radio Parts.
—How to Patent Your Radio Inventions.
—How to Solder.

December, 1926
—Uncle Sam's New Short-Wave Net.
—How Circuit Resistance Affects Selectivity.
—POPULAR RADIO Circuits
—How to Build the LC-Intermediate Power-Pack.
—Inside Information on New Radio Receivers.

January, 1927
—How to Build the New KH-27 Receiver.
—To Start and Stop Your Set Automatically.
—POPULAR RADIO Circuits.
—The Quack Doctors of Radio.
—How to Build the LC Junior Power-Pack.

POPULAR RADIO

119 West 57th Street New York, N. Y.

Type 4A
Type 4D

The New *Diamond Cut*
PRECISION COILS
are now the
"Standard of Comparison"

The type 4A coils are probably the most accurate coils on the market today. Secondaries are wound to the extreme accuracy of 2-10ths of 1 per cent. Price per set of three, $6.50. Type 4D more compact, but not as accurate, $5. Designed for .00035 Condensers.

Type 3B

Designed expressly for the experimenter who desires a tuning unit of as flexible a character as is possible to combine in one design. Equipped for single hole mounting. Price, type 3B, $3.75.

Send for our new catalogue.

Precision Coil Co., Inc.
209 Centre St., New York, N. Y.

TONATROL

Exclusively Licensed by Technidyne Corporation under U. S. Patent No. 1593658, July 27, 1926.

Instantly!

From a Whisper to Full Power

"TONATROL"
A True Tone and Volume Control

Music soft and soothing enough to lull the baby to sleep—or powerful, heart-thrilling tones—these are instantly secured with "Tonatrol."

"Tonatrol" is the most efficient instrument yet developed for controlling tone and volume. Made with genuine bakelite to last. Quick and simple to install.

Tonatrol—Standard Volume Control, $1.50

Tonatrol—Type W. S. (with filament switch attached) $2.00

Write for free installation booklet for the correct way to control volume

Dept. 43C, 175 Varick St., New York, N. Y.

ELECTRAD Inc

and 16, from the direct-current supply, 17, are connected respectively to the points, 12 and 18, the latter of which is substantially of the same potential as points 12 and 13, due to the small reactance from condenser 11.

The condenser, 11, functions as a blocking condenser to prevent the positive high potential of the source, 17, from being impressed upon the grid.

The grid and the plate leads are connected to points 19 and 20, respectively, of the oscillatory circuit. These points are necessarily always of opposite polarity.

As the filament, 2, is connected to the point, 12, which is midway between the potentials of points 19 and 20, it is obvious that the circuits meet the well-known definition of a vacuum-tube oscillation generator.

When working at such short wavelengths as those referred to, it is obvious that the capacities of condensers 9 and 10 and the inductances of coils 7 and 8 will be extremely small. In practice, the inductances, 7 and 8, may each consist of a half-turn of No. 8 copper wire, the radius of the turn being about two inches.

Coil 7 is shown inductively associated with a secondary coil, 21, the terminals of which may be connected to an antenna or other output circuit. Coil 21 may likewise consist of a half-turn of radius.

Condensers 9 and 10 may be of unequal capacity, provided inductances 7 and 8 are likewise unequal, so that the bridge is maintained at an approximate balance for all settings.

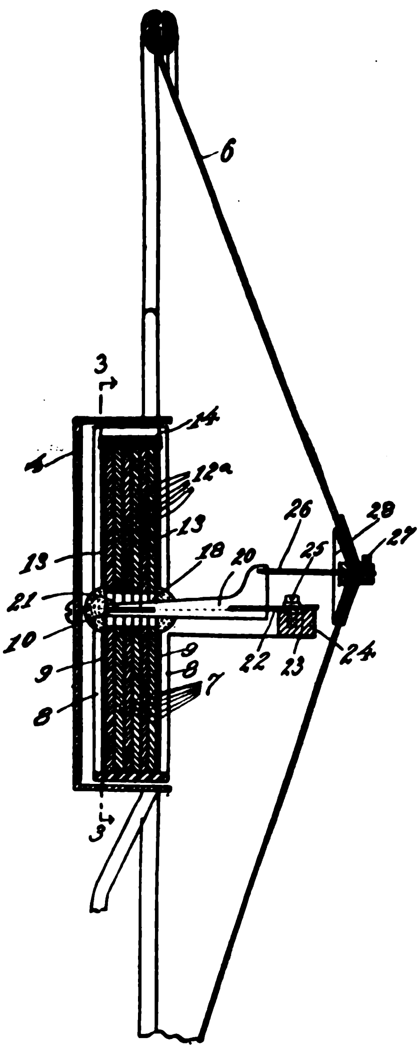
If the bridge circuit is so balanced that the high-frequency potentials at points 12 and 18 are exactly equal, it is apparent that no high-frequency current flows through the direct-current source, 17, and therefore that any disturbances occuring in the direct-circuit source or leads 15 and 16 have no effect on the frequency generated.

Although the invention is of special importance for short-wave transmission, its operation is equally good at longer waves.

An Improvement in Loudspeaker Construction

PATENT number 1,583,490, illustrated in Figure 9, has been issued to Charles W. Peterson of Ann Arbor, Mich., for improvements in the mechanical features of cone-type loudspeakers.

The main improvement is in the link system that transmits the motion of this armature of the diaphragm. The ends of the armature are still held between the yokes or side arms of the two magnets, but the center of the armature is connected to one arm of a pivoted lever. This lever in turn transmits the motion of the armature to the diaphragm at the proper lever arm distance from the fulcrum point.



AN IMPROVED LOUDSPEAKER

FIGURE 9: *A new link system that transmits the motion of the armature to the diaphragm with reduced motion and increased force is the main feature of this new cone speaker.*

In the type shown in Figure 9, the long lever arm is connected to the armature, and a short lever arm, at right angles to the first, is connected to the center of a cone diaphragm, giving a motion of less amplitude and greater force to the diaphragm than that of the armature itself.

This reduction of motion and increase of force is very desirable in connection with cone-type diaphragms. Having the two lever arms at right angles, as shown, permits a more compact and efficient construction than if the two were in line.

In case the two lever arms are equal, the diaphragm will vibrate with the same amplitude as the armature, the same as when the two are connected by a straight rod link.

Another feature is the provision of a simple way to simultaneously adjust the armature into its central position in the air gap, and a simple and efficient fulcrum for the lever. This object is accomplished by the use of a resilient spring fulcrum, a screw and a depression in the mounting surface so arranged that while tightening the screw the air gap is adjusted.

NA-ALD
TRUPHONIC AMPLIFICATION

as its name implies

TRUE MUSIC

Complete new audio unit for any radio set, irrespective of age, design or manufacturer

THE SKILLED RADIO ENGINEER knows that the improvements made in radio reproduction during recent years are principally in audio-frequency amplifiers. The set of yesterday is antiquated, almost solely because its audio-frequency apparatus does not reproduce all the frequencies of the full musical scale. The mellow and rich low notes are practically absent, resulting in nasal, colorless music. The Alden Truphonic Power Amplifier overcomes and corrects this; completes the musical scale.

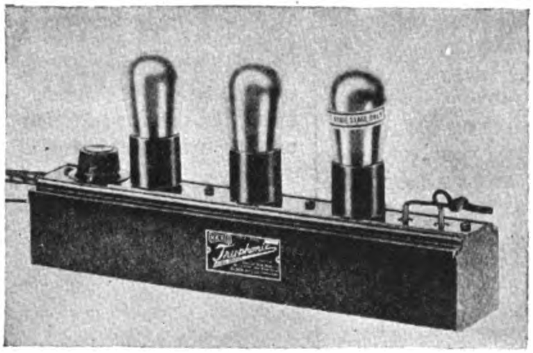
The marvelous Alden Truphonic Amplifier is the result of the very latest and best engineering discovery and practice, and through it any radio set regardless of its age, its design, or its original manufacturer, may be brought up to the 1928 standard of quality reproduction, by the simple expedient of a few quick connections that any tyro can make.

The result will match, and even surpass, many of the high-price sets of today. Music of a quality hitherto unobtainable is made instantly available through the quick and convenient attachment of an Alden Truphonic Amplifier. In addition, it supplies splendid audio-amplification for any of the Electrical Phonograph Reproducers.

You may purchase the complete Alden Truphonic Power Amplifier from any good dealer, and rejuvenate your set in a moment's time for only $25.00. Or you may purchase essential parts, and build into any new set you may be constructing, for only $15.00.

In either case, by adopting the Alden Truphonic Power Amplifier, you will assure at once the very latest audio development for your radio and phonograph enjoyment.

—attach it to any set



NO. 304 ALDEN TRUPHONIC AMPLIFIER may be attached in 2 minutes to any radio set or phonograph. No changes to make in set. Improves amplification and greatly increases power.

It is a small, compact instrument, which displaces and entirely changes the old amplification of your set. As if by magic, it brings out the true musical qualities, heretofore completely missed or distorted by old-fashioned audio-frequency systems.

The Alden Truphonic Amplifier is delivered complete in a beautifully finished case, with labeled leads for quick and simple attachment to any receiver, regardless of type. Volume control is built in, and phone tip-jacks are included. Everything complete, with instructions for easy attachment. Price $25.00.

SET CONSTRUCTORS may obtain the No. 303 Alden Truphonic Audio Amplification Set, price $15.00. Consists of three steel-encased Truphonic Couplers, equipped with adaptable mounting brackets. Truphonic is an entirely new principle, not to be confused with resistance, impedance or transformer coupling; does not oscillate with "B" Battery eliminators. Bring the audio amplification in your new set up to the latest standards through the simple use of these Alden Truphonic units. DEALERS are finding a quick, delighted and never-ending market for the Alden Truphonic. Every unit complete in itself, splendidly packed, with full instructions for quick attachment.

FOR MORE DETAILED INFORMATION, ADDRESS

ALDEN MANUFACTURING COMPANY, SPRINGFIELD, MASSACHUSETTS

First in the Field
Specializing in
Cockaday Kits

S. HAMMER RADIO CO., 303 Atkins Ave.
Brooklyn, New York

Cockaday Sets Now Made Easier to Build by Our New "Ready-to-Wire" Plan

50% of Your Time, Work and Worry SAVED!

All you need do is to connect bus-bar according to diagram, solder and your set is finished. These Kits are sent to you completely mounted, and assembled on a Veneered Mahogany baseboard and genuine bakelite panel, drilled and engraved. Genuine parts used as listed below; exactly as used in Mr. Cockaday's Laboratory Model. COMPARE OUR OFFER!

NEW! COCKADAY LC-28 RECEIVER

4 Hammarlund Mid-Line Variable Condensers, .000275 mfd. @ $5.10	$20.40
1 Hammarlund Double Drum Dial	6.00
1 Set of Precision Radio Frequency Transformers, type 4-B	12.50
3 Samson High Frequency Chokes, type No. 125, @ $2.25	6.75
1 Samson High Frequency Choke, type No. 85	2.00
3 Aerovox Moulded Condensers, .02 mfd., @ $1.50	4.50
1 Aerovox Moulded Condenser, .00025 mfd.	.35
1 Aerovox Moulded Condenser, .00075 mfd.	.40
1 Yaxley Combination Switch and Rheostat, 6 ohms, No. 906-K	1.75
1 Yaxley Cable Connector Plug with Cable, type 660	3.00
4 Carter Fixed Resistance 4 ohms, type H-4, @ 25c	1.00
2 Carter Imp. Plugs and Tip Jacks, marked "antenna" and "ground," respectively, with insulating washers for antenna jack. Complete set	$0.65
4 Benjamin Vibrationless Sockets @ 75c	3.00
1 Lynch Single Resistance Mountings	.35
1 Lynch Suppressor, 500 ohms	1.50
1 Lynch Suppressor, 600 ohms	1.50
1 Lynch Suppressor, 700 ohms	1.50
1 Durham Metallized Resistor, 6 meg	.50
2 Tait Brackets	2.00
1 Alcoa Aluminum Chassis	7.50
4 Sets Special Aluminum Box Shields for LC-28 @ $2.00	8.00
1 Aluminum Panel, 6"x26"	4.50
1 ¼" Extension Shaft	.50

READY-TO-WIRE KIT, PRICE $90.15

POWER PACK—AUDIO AMPLIFIER and LC-28 UNIPAC

A. C. Improved Shielded Laboratory Receiver—in Stock !!

COMPLETE KITS Magnaformer 9-8 CIRCUIT IN STOCK

NEW! HAMMARLUND ROBERTS HI-Q SIX

Our New 1928 Catalog Is Now Ready. **Send For It NOW!**

ZRF the New R·F·amplifier

Maximum amplification per stage of radio frequency is possible *only* when the tube characteristics match up properly with the rest of the circuit. To meet the requirements determined by Laurence M. Cockaday's experiments, the new ZRF has been especially designed for radio frequency amplification. Plate impedance 6000 ohms, amplification factor 8.5, and a mutual conductance of 1400 micromhos, resulted in an output per stage 33⅓% greater than with any other tube obtainable.

Here is a tube with a low input capacity between the elements (which greatly reduces feed-back) and an exceptionally low plate impedance—the two most important requirements.

Used under proper operating conditions ZRF will give greater volume—greater distance—clearer tone—bringing in every note, high or low, without distortion. ZRF is a ¼ ampere oxide-coated filament tube. Filament control, for most satisfactory operation, is best secured by rheostat or other adjustable resistance in series with ballast resistors.

Experimenters and engineers are invited to write our staff for actual working characteristics of this new tube.

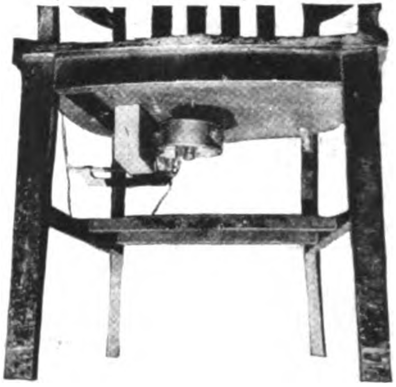
Don't use Zetka tubes unless you can operate them properly

ZETKA LABORATORIES
Incorporated
73 WINTHROP STREET
NEWARK, NEW JERSEY

ZETKA
The Clear-Glass Tube

Radio "Spooks" All Over the House!

(*Continued from page 416*)



THE VOICE FROM BENEATH
The installation of the reproducer on the under side of a chair is easily done with a small wooden block to which to fasten the reproducer clamp.

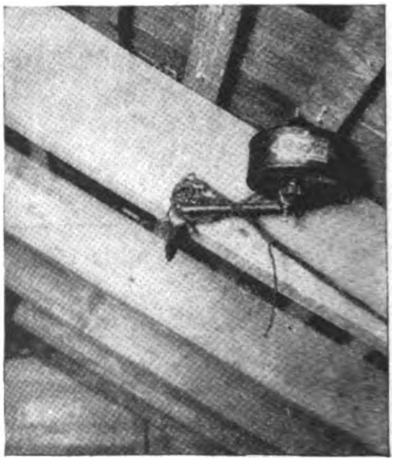
from WEAF, was guilty each morning of awakening the guest at an hour at which he was, in all probability, unaccustomed to arising.

In the cellar the visitor is shown a speaker unit attached to the floor of the living-room. Visitors to the house even feel the tingle of music through the soles of their shoes.

While the applications outlined above are ingenious, the means of carrying them out is comparatively simple, although it involves a little work and a lot of wires, to say nothing of a lot of opposition on the part of the housewife.

All the terminals of the various units used terminate at a special switch near the receiver itself. This is so concealed that the operator, without arousing the least suspicion on the part of the guest, can make the various changes that are necessary.

Needless to say, this fun cannot be had without a power valve of the 210 type. At least twenty milliamperes must be flowing through the speaker unit to bring about the desired results.



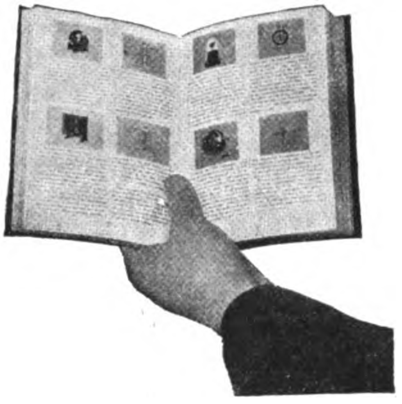
MAKING THE SHINGLES SING
The last word in radio mystification is this installation, by which the whole roof can be made to broadcast setting-up exercises to the next-door neighbors.

TWENTY OF THE WORLD'S GREATEST RADIO SCIENTISTS WROTE A SINGLE BOOK

AND POPULAR RADIO CALLED IT

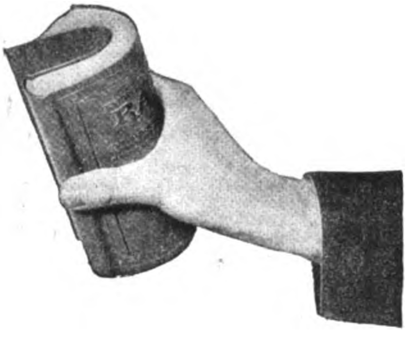
"EVERYMAN'S GUIDE TO RADIO"

Contributed to by the world's leading radio scientists, without question, the most comprehensive, most interesting and absorbing, and the most complete radio book yet published in any country. It is impossible to give comparisons, because comparisons do not exist. One must read Marconi on the subject of "beam transmission"; the late Charles Steinmetz on "Waves"; Sir Oliver Lodge on Coils, or Ambrose Fleming on "Vacuum Tubes," before the significance of these writings of the masters of the art can be fully appreciated.



1300 Illustrations!

"Everyman's Guide to Radio" contains 1300 beautifully engraved illustrations in 1200 pages of text.



Flexible!

These four books represent the latest practice in the art of book manufacture. Perfectly flexible, without damage to pages or binding.

Convenient!

A lot of information in a small space. Just the [illegible] for the pocket and light in weight.

640 PAGES OF INSTRUCTIVE READING

For the "Broadcatcher" as Well as the Experienced Radio Enthusiast

This book of 640 pages, size 5¼" x7½", containing more than 1300 finely engraved illustrations, has been prepared by some of the greatest physicists and engineers of radio. "Everyman's Guide to Radio" stands as the first successful effort to meet the needs of all those who aspire to attainments in the science, whether they are "broadcatchers," skilled service men or students. This vast wealth of information represents studied compilation that has extended over two whole years and includes every phase of radio communication that can have any interest to those desiring meaty information.

QUICK ANSWER TO EVERY RADIO PROBLEM

Intelligent use of "Everyman's Guide to Radio" gives quick, understandable answers to practically every radio problem regardless of the technical accomplishment of the reader. Special emphasis has been laid on the illustrations contained in the "Guide." Hundreds of specially prepared drawings and photographs answer most radio problems at a mere glance. No effort or expense has been spared to make the "Guide" of maximum value to radio listeners. It is the fascinating story of radio in pictures and it is the most complete collection of instructive radio photographs ever published.

A BOOK YOU WILL BE PROUD TO OWN

It may be said without reserve, that "Everyman's Guide to Radio" is the most artistic and practical book ever published in the radio field. It contains over 640 pages printed on heavy calendered paper in legible type, making for the comfort and convenience of the reader. The covers are beautifully embossed and bound in Art Fabrikoid, better than leather, flexible, making the books conveniently portable.

CONDENSED TABLE OF CONTENTS

Part 1
- The First Principles of Radio
- The Electricity of Radio
- The Easy Principles of Diagram Reading
- How Waves Are Generated
- Mechanics of Tuning
- Detection and the Secret of Vacuum Tubes

Part 2
- Audio Frequency Amplification
- Radio Frequency Amplification
- Variable Condensers
- Coils—How to Use Them
- Improvement of Broadcast Reception

Part 3
- How to Make Radio Improvements
- Learning the Language of Dots and Dashes
- Batteries and Battery Chargers
- Different Types of Radio Receivers

Part 4
- Accessories and Radio
- Wonders of Radio Transmission

POPULAR RADIO, 119 West 57th St., New York

EXAMINE THE VOLUME WITHOUT OBLIGATION TO BUY

So sure are the publishers of "Everyman's Guide to Radio" that this volume is just what everyone needs to complete his reference library and so sure are they that it is the most practical, complete and beautiful radio book yet published that they are willing to mail it to those interested for examination without obligation to buy. Just fill out the attached coupon and mail. The book will be mailed immediately. Upon arrival, you pay the postman $4.00 plus postage. Examine the book for 5 days. If, after that time, you are not convinced of the value to you, return in good condition and your money will be refunded, at once and in full, without question.

$ 4.00

POPULAR RADIO, Inc.,
119 West 57th Street,
New York, N. Y.

Gentlemen:

Send me "Everyman's Guide to Radio" in one volume. I agree to pay the postman $4.00, plus postage. If, after carefully examining the book for a period of five days, I do not like it I will have the privilege of returning it to you and my money, in full, will be immediately returned.

Name..

Address.......................................

City..........................State............

Acme ANTENNA

–with Seven Strands of enameled Copper Wire

Best outdoor antenna you can buy. Seven strands of enameled copper wire. Presents maximum surface for reception, resists corrosion; this greatly improves the signal. Outside diameters equal to sizes 14 and 16. (We also offer solid and stranded bare, and stranded tinned antenna.)

Loop Antenna Wire

Sixty strands of No. 38 bare copper wire for flexibility, 5 strands of No. 36 phosphor bronze to prevent stretching. Green or brown silk covering; best loop wire possible to make.

Battery Cable

A rayon-covered cable of 5, 6, 7, 8 or 9 vari-colored Flexible Celatsite wires for connecting batteries or eliminator to set. Plainly tabbed; easy to connect. Gives set an orderly appearance.

Acme Celatsite Wire

Tinned copper bus bar hook-up wire with non-inflammable Celatsite insulation, in 9 beautiful colors. Strips easily, solders readily, won't crack at bends. Sizes 14, 16, 18, 19; 30 inch lengths.

Flexible Celatsite for sub-panel wiring

A cable of fine, tinned copper wires with non-inflammable Celatsite insulation. Ideal for sub-panel or point-to-point wiring. Strips easily, solders readily. Nine beautiful colors; *sold only in 25 ft. coils, in cartons colored to match contents.*

Spaghetti Tubing

Oil, moisture, acid proof; highly dielectric — used by leading engineers. Nine colors, for wire sizes 12 to 18; 30 inch lengths. (We also make tinned bus bar, round and square, in 2 and 2½ ft. lengths.)

Send for folder
THE ACME WIRE CO., Dept. P
New Haven, Conn.

ACME WIRE
MAKES BETTER RADIO

Transoceanic Calls Heard

POPULAR RADIO'S "Calls Heard" Department is ready to serve all American amateurs by forwarding their calls heard (QSL) cards to their proper destination in foreign countries. These cards are delivered through agents in those countries who have or can obtain knowledge of the present address of foreign amteurs. POPULAR RADIO is also doing the foreign amateur the service of forwarding his QSL cards to the proper destination in this country. In addition, the magazine will publish a monthly list in the "Transoceanic Calls Heard" column. Address your cards to the foreign amateurs by call number and enclose them in envelopes to—

The Calls Heard Editor
POPULAR RADIO
119 West 57th Street, New York

THE following stations in the United States were received and logged at the amateur station of Dr. L. Bailleul (EF-8EZ), at 119, Boulevard de Belfort, Roubaix (Nord), France, using a Schnell circuit with detector and one stage of low frequency:

1ADM, 1ADS, 1AFF, 1ALR, 1BHM, 1CMP, 1CNZ, 1SZ, 1VS, 1XV, 2AGN, 2AMF, 2ATS, 2AWQ, 2AZK, 2BCU, 2CI, 2CRB, 2CUQ, 3AUW, 3BLP, 3BUV, 3BVA, 3CJN, 3IU, 3QE, 4DX, 4UX, 5DI, 6AM, 6TA, 7DF, 8DRJ, 8JQ, 8LI, 8QB, 8SF, 9BPB.

AMATEUR station F-8SM, operated by J. M. Sacazes, Toulouse, France, reports the reception of the following stations in the United States, using a low-loss tuner with one stage of low frequency:

1BHW, 1CMP, 1CKP, 1MV, 1ON, 2BOW, 2GX, 2TF, 3AHL, 3BWT, 8LT, 9ADK, 9ARW.

AMATEUR station EF-8NOX, Paris, France, reports the reception of the following stations in the United States, receiving with a Schnell circuit:

1AHG, 1CPB, 1NK, 1ZL, 2AWX, 2NM, 2TP, 3QV, 5ATF, 5OA, 8AHC.

THE following stations are reported as received and logged at the amateur station, F-8XIX, Avignon, France, with a Bourne circuit and one stage of low requency:

1DI, 1GA, 1IC, 1RN, 2BBB, 4AAH, 4IO, 8IJV, 9BJP, 9ELI.

AMATEUR station F-8YOR, operated by Professor M. Reyt, Orleans, France, reports the reception of the following stations in the United States, using a low-loss three-circuit tuner and one stage of low frequency:

3BMS, 4TU, 5GL, 8ALF, 9AOR, 9ARN, 9AXB, 9BGE, 9BHT, 9BPM, 9BVH, 9CHN, 9CVN, 9EF, 9MH, 9XI.

THE following stations in the United States were received and logged at the amateur station of A. Chaye-Dalmar (F-8GM), Saint-Brieuc (Cotes-du-Nord), France, with a Bourne circuit and one stage of low frequency:

1AHI, 1CJC, 1CJH, 1GA, 2AQW, 2AWX, 3AGU, 3AZT, 5KC, 8ABG, 8ALY, 8AXA, 8BAD, 8BEN.

Sets Easy To Build *With* Popular Radio BLUE PRINTS

You can have your choice of any one set of POPULAR RADIO Simplified Blueprints with your new or renewal subscription for POPULAR RADIO, accompanied by remittance of $3.00. These Blueprints will make it possible for you to build a tested and approved set. You, as a reader of POPULAR RADIO, know the many entertaining, interesting and instructive articles that are published each month. We promise that throughout the coming months POPULAR RADIO will hold more and more of interest for Radio Fans.

Ease, Economy and Accuracy in Construction

Simplified Blueprints make it possible for anyone, without previous knowledge of radio, to construct a highly efficient radio receiver. These Blueprints consist of 3 diagrams as follows:

Panel Pattern

This Blueprint is the EXACT size of the actual set. So accurate that you need merely lay it on your panel and drill as indicated. No scaling or measuring to do, no danger of ruining the panel through faulty calculation.

Instrument Layout

Here again you have an actual size print of each instrument and binding post and its exact location both on the panel and within the cabinet.

Wiring Diagram

The unusual feature of this Blueprint is that it is an actual size picture diagram of the finished set. Each instrument and other parts appear in exact size and the wires are so clearly traced from one contact to another that you can connect all terminals accurately without even knowing how to read a hook-up diagram.

Set No. 18—*"The Improved Raytheon Power-Pack"* (as described in the May, 1926, issue of POPULAR RADIO).
Set No. 22—*"The LC-27 Broadcast Receiver"* (as described in the October, 1926, issue of POPULAR RADIO).
Set No. 23—*"The LC-Senior Power-Pack"* (as described in the November, 1926, issue of POPULAR RADIO).
Set No. 24—*"The LC-Intermediate Power-Pack"* (as described in the December, 1926, issue of POPULAR RADIO).
Set No. 25—*"The LC-Junior Power-Pack"* (as described in the January, 1927, issue of POPULAR RADIO).

Use coupon below; indicate which set of Blueprints you want.

POPULAR RADIO
Dept. 49
119 West 57th Street New York City

POPULAR RADIO, Dept. 49
119 West 57th Street, New York City

Enclosed is my remittance of $...... in full payment for subscription, with Blueprints as checked below, FREE.

☐ **Set Number 18** ☐ **Set Number 23**
☐ **Set Number 22** ☐ **Set Number 24**
☐ **Set Number 25**

Name...

Street...

City........................ State............

THE following stations in the United States were received and logged at the amateur station of M. Meidieu (EF-8ARO), at Belfort, France, using a detector and one stage of low frequency:

1ADM, 1AQT, 1ARC, 1AVL, 1CNZ, 1VW, 2ADL, 2AYJ, 2AZK, 2CRB, 2CUQ, 2CYX, 2GX, 2HC, 2IZ, 2JN, 2TR, 2PZ, 3ACW, 3AEF, 3AFU, 3AKS, 3QE, 3SZ, 4DX, 4LK, 4RN, 4RR, 8ALY, 8BTH, 8DHX, 8JQ, 9ARA, 9DIJ.

THE following stations in the United States were received and logged at the amateur station of Herbert A. Paltschik, Wickersdorf, Germany, using a detector and one stage of low frequency:

1AFF, 1AG, 1AGA, 1AHV, 1AKM, 1ALR, 1AUR, 1AYL, 1BDI, 1BFW, 1BHW, 1CKP, 1CNF, 1IC, 1LX, 1MK, 1NO, 1RN, 1XM, 1ZD, 2AAN, 2AGN, 2AMF, 2AMJ, 2APD, 2AVB, 2AZK, 2BC, 2BCM, 2BGZ, 2CDR, 2CRB, 2CUG, 2CXL, 2CYX, 2DOW, 2GX, 2HC, 2TP, 2UB, 2UO, 2VD, 2WR, 2XAJ, 2ZA, 3ADD, 3AHL, 3BCO, 4GY, 4IZ, 4LK, 4WC, 8HB, 9ADG.

THE following stations in the United States were received and logged at the amateur station of Paul Tabey (F-8KU), Lyon, France, using a Schnell circuit with detector and one stage of low frequency:

1BDX, 2AMJ, 2ASE, 2BQD, 3AFW, 3IU, 3IZ, 3QE, 3SZ, 8CFR, 9BQE.

THE following stations in the United States were received and logged at the amateur station of R. and A. Aronssohn (F-8FT), Colombes, France, using a Schnell circuit with detector and one stage of low frequency and an indoor aerial:

1AFF, 1AJM, 1BKV, 1CAW, 1CCZ, 1CJH, 1LW, 1ON, 1XF, 1XM, 1ZL, 1ZZ, 2PZ, 6AGR, 6CLN, 6HJ, 8ADM.

STATION EF-8UDI, operated by A. Yvon, Paris, France, reports the reception of the following stations in the United States, receiving with a Bourne detector and one stage of low frequency:

1ACH, 1ASU, 1BUX, 1BYV, 1CAU, 1CPB, 1LU, 1ZL, 1ZZ, 2ASC, 2AGW, 2AHM, 2ASL, 2CNG, 2JN, 5OA, 8ADG.

GEORGES SOLET, operator of the amateur station TUN2, Bizerta, Tunis, reports receiving the following stations in the United States, receiving with a Bourne circuit and one stage of low frequency:

1AAO, 1ADM, 1AHI, 1AJM, 1BYV, 1CMX, 1FL, 1IC, 1RF, 1UW, 2AHM, 2GP, 5AFB, 8ALY, 8AXA, 8BEN, 8GZ, 9EF.

The amateur station of Pierre Louis (F-8BF), Dijon, France, reports the reception of the following stations in the United States, using a detector and one stage of low frequency:

1AKZ, 1ALR, 1GH, 2EB, 3PF, 9BN.

FREE

Greater Values are Shown in our New Big 1928 Dealers' Catalog

EVERYTHING new and desired—all under one roof. You don't need to look elsewhere. Complete stock carried. Prompt, efficient, dependable service.

New Kits featured include: Aero—Bodine—Camfield—Citizens—H-F-L—Infradyne—Karas—Melo-Heald—Scott's—Silver Marshall—St. James—Tyrman—etc.

Write for your copy today.
See what you SAVE.

Established 1918

TELMACO

TELEPHONE MAINTENANCE CO.
123 South Wells Street Dept. 54 Chicago, Illinois

CHICAGO'S OLDEST RADIO HOUSE

WHOLESALE ONLY.

A NEW PRODUCT by FERBEND
F
F
FERBEND HEAVY DUTY SOCKET B POWER
MODEL
FERBEND ELECTRIC CO. CHICAGO U.S.A.
Heavy Duty 'B' Power Unit with Long Life Perfected 85 Mil. TUBE
$18.50 Complete Including TUBE

No Liquids or Acids

Important New Features

Delivers up to 180 volts on any set, regardless of the number of tubes. Ample reserve power.

All voltages are fixed with permanent resistors. Output tapped at 22½, 45, 67½, 90, 135 and 180. This gives requisite voltage for any set. No variable resistors to change value and require retuning.

The input from the lighting circuit is controlled by a rheostat which can be set once for the proper amount of current and then forgotten.

A PERFECTED long-life rectifying tube (non-filament type) is used.

All connections are concealed under the lid as required by the Underwriters Laboratories. This also prevents tampering with connections after they are once made.

The Ferbend HEAVY DUTY "B" Unit is finished in handsome black crystalline and is furnished with a six foot flexible cord and switch.

NOISELESS—EFFICIENT

In this present day of high priced power units, Ferbend again pioneers with a *Tube-Type* Heavy Duty "B" Unit of unsurpassed quality at a price "Within reach of all."

Over 100,000 users prove the worth of Ferbend products. Now, in spite of rising competition, Ferbend sales are increasing. The truth of the matter is that as stablization of the Radio Industry approaches, more people buy because of recognized MERIT. The new Ferbend "B" Unit will be popular with radio owners because it is everything that can be desired in this type socket power.

Try It! We want you to put the new Ferbend "B" unit side by side with any other make regardless of price. We INVITE comparison. We know you will instantly appreciate the fact that for workmanship or performance and in materials and appearance, there is no better "B" Power Unit made.

See Your Dealer—or Send Direct

Shipment will be made upon receipt of price, or C. O. D. if you wish. Use for thirty days to your own pleasure—then if not satisfied write us within that time and purchase price will be refunded. Send Coupon NOW!

FERBEND ELECTRIC CO.
419 West Superior Street Chicago, Illinois

30 Days Trial

Purchase price will be refunded if not satisfactory in every way.

FERBEND ELECTRIC CO.,
419 W. Superior St., Chicago, Ill.
Send HEAVY DUTY B unit at once.
( ) I enclose $18.50 ( ) Send C. O. D.
( ) Send literature.

Name ....

Address ....

City .... State ....

Radio Since 1921

AMERTRAN

New Realism
More Volume
Less Distortion

GET THESE RESULTS with the new AmerTran Push-Pull Power Amplifier. It is a completely assembled two-stage unit embodying a first stage AmerTran De Luxe followed by AmerTran Input and Output Transformers for Power Tubes. The metal box has four sockets, two for power tubes, and a four prong and a five prong socket in the first stage for either a standard amplifying tube or the UX-201 A type, or a UY-227 (C-327) A. C. tube. Using the latter tube, the amplifier can be entirely A. C. operated.

This amplifier can be connected to the detector of any good receiver, replacing the audio amplifier. When operated from a power source supplying sufficient voltage, the reproduction will be as perfect as the speaker is capable of making it. In addition, distortion, and the hum from raw A. C. on the power tubes are eliminated. The energy output to the speaker, especially at the lower musical frequencies also is increased.

It is recommended that this amplifier be operated from the AmerTran A. B. C. Hi-Power Box, but it can be used with any good power supply system or batteries. Tone realism and volume will be finest, with the largest available power tubes in the power stage. Therefore, UX-210 or CX-310 tubes will normally be supplied. If the 171 type of tube is preferred, the amplifier will be equipped with the AmerTran Type 271 Output Transformer.

AmerTran Push-Pull Amplifier as a complete unit is licensed under patents owned or controlled by the Radio Corporation of America and must be sold complete with tubes. When ordering, please state choice of tube for the first stage (either UX-201A or UY-227, or Cunningham equivalent) and either two (UX-210, CX-310) or two (UX-171, CX-371) power tubes for the power stage. Price on application.

Send for further information.
Inquiries on this new unit will be handled promptly.

AMERICAN TRANSFORMER CO.

178 Emmet Street **Newark, N. J.**

"Transformer Builders for Over 26 Years"

American Transformer Company Transformer Builders for Over Twenty-Six Years

$55. At this price the Crosley Bandbox is Radio's most astonishing success, *not* because the price is low, *but* because the set is magic!

The ability of the new Bandbox is amazing. Its simple operation is easily understood and its wonderful performance is at the command of any hand that can turn the dial.

Millions are making up their minds today to buy a radio.

Millions will replace obsolete sets with new, up-to-date receivers this fall.

Experienced radio owners will look first for 3 fundamental points and to every set they consider will address these questions:

1. Is it selective?
2. Is it sensitive?
3. Is it easy to operate?

Satisfied on these points they will look for:

1. Single dial control.
2. Illuminated dial.
3. Volume control.
4. Single cable leads.
5. Console installation adaptability.
6. Reasonable price.

Millions will look at the Crosley Bandbox. This amazing little set is now displayed by more than 16,000 dealers.

One dealer, alone, expects to sell a million dollars' worth of Bandboxes this season.

Crosley dealers from Maine to California have this wonderful receiver hooked up for immediate demonstration and will explain its matchless performance in a manner somewhat like this:

The Crosley Bandbox is a 6-tube receiver.

The circuit of this set is of the excellence you would expect from a group of skilled engineers suddenly given the pick of the world's radio patents to work with.

Crosley has always given the radio world its biggest value for its dollar. Contemplate the perfection possible when the doors of the research and development laboratories of The Radio Corporation of America, The General Electric Co., The Westinghouse Co., The American Telephone & Telegraph Co., and the Hazeltine and Latour Corporations were thrown open.

Licensed under their patents!

Musicone Tilt-Table
$27.50

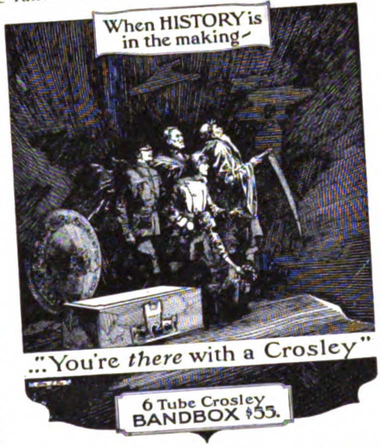
Tremendous! Wonderful! Significant!

Simply it means that millions will possess the best radio performance possible at the low prices for which Crosley is already famous.

The Crosley Bandbox is totally and completely shielded. Every element is absolutely separated from every other element by solid shielding. Coils are covered with copper. This could have been done cheaper but efficiency would have been sacrificed. Condensers are housed in cadmium-plated steel. All wiring is separated and shielded from all other parts of the receiver. Solid, sturdy, substantial, the entire set is assembled on a heavy metal chassis.

The tuned radio frequency amplification stages have been absolutely balanced through use of the Neutrodyne principle. The set is a genuine Neutrodyne!

To the initiated this means much. To the layman it manifests itself only as a radio receiver that does not squeal or howl when you are trying to get a station.


When HISTORY is in the making—
..."You're *there* with a Crosley"
6 Tube Crosley BANDBOX $55.

The foregoing answers for the Crosley Bandbox the three fundamental questions set forth in the fourth paragraph, which the experienced radio owner is asking of every set he sees this fall.

The shielding makes the Bandbox highly selective—the circuit, acutely sensitive and the design, extremely easy to operate.

The Bandbox is operated with a single station selector (one dial).

In most localities and in most owners' hands the single station selector will find all the programs anyone could possibly wish. But there are some owners who demand greater ability like the possessors of 90 horse power motor cars who may never step on it but like to be conscious it's there. For such have the Acuminators been designed. Far away stations of weak power but perhaps good music are captured by the use of these little auxiliary tuners. Their function is best likened to a pair of field glasses. As the lens bring the distant scene to nearby aspect, so do the acuminators bring the remote station signals up to room filling volume. Ordinary one dial radios can never perform like this. Hair line tracking of the condensers together is difficult—but the Acuminators, little secondary adjustments *exclusive* to Crosley give the Bandbox a substantial command of the air and *all* that is in it.

The dial of the Bandbox is illuminated. A detail! A refinement added but not as an excuse to raise the price. For shadowy corners and dim eyesight it recommends itself.

Volume Control is necessary on good radio today. Nearby and high powered stations send terrific impulses into the receiver. Detuning has been a favorite method of softening this loud reception but with stations closer and closer together on the dial detuning, particularly in large cities, creates an overlapping of programs. The ear like the eye is only good for one thing at a time. Under the towers of the heaviest stations the volume control of the Bandbox cuts the loudest blast down to a veritable whisper. No distortion whatsoever!

A single cable leads all outside and power connections from the Bandbox. In this brown fabric covered cable lies each lead covered with colored rubber for protection, accuracy and easy assembly. Tidy housewives appreciate it.

The adaptability of the Bandbox to installation in all types of cabinets is a feature. The metal case of the Bandbox lifts off the chassis. This leaves the closely grouped dial, switch and volume control shafts to be stuck through holes in the panel of any sort of cabinet. The escutcheon is quickly screwed over them and the console installation is not only complete but has no earmarks of a makeshift.

Much has influenced the $55 price of the Bandbox.

First, an ideal and an idea.

Then, a working out of the idea.

And now, the constant possession of the ideal.

Back before radio became the entertainment force it is today Powel Crosley, Jr., held an ideal that the things which give people pleasure should be made to sell at low prices so that millions may enjoy them.

When radio was a bundle of hair pins turned with the knobs from typewriter carriages, he had the idea that if he could make radios in sufficient quantities, he could supply millions with a means of enjoying this new source of pleasure at moderate prices.

Every radio year has been a year of mass production experience to Crosley. This year saw an investment of over half a million dollars in equipment that a fine radio might be made at such speed and in such quantities that a price of nearly half a hundred dollars could be maintained.

Throughout the country millions examine the Bandbox today. They see it the achievement of an organization who began its developments when radio as we know it today began. Its success has been tremendous if clamorous demands from dealers are any indication. Skeptics, the unbiased and the radio wise have pronounced it GREAT. Even at any price it would be a sensation, for its performance ranks with the most expensive and fanciest radio receivers on the market.

An AC model Bandbox takes its power from the electric light.

Former power supply with its constant annoyance and expense is entirely eliminated.

Power Converter

The new R.C.A. AC tubes provide clear, smooth and loud reception comparable in every way to the most efficient wet storage battery power.

Alternating current ripple is smoothed out in the compact little power converter which is sold with the AC Bandbox. This device needs no attention—is half the size of an ordinary storage "A" battery and matches the Bandbox in finish and color.

The AC Bandbox with
The Power Converter is $110

This gives you a complete, direct AC radio adaptable to any type of installation you may choose—bookcase, console, desk, cabinet, arm chair or tuck it away on the corner of the table—for $110.00.

THE CROSLEY MUSICONES ARE AS OUTSTANDING IN THEIR FIELD AS THE BANDBOX IS IN ITS

Back in early 1925 radio's audibility above the single telephone ear unit depended upon a horn. Unnatural and harsh it laid a handicap on a fast developing industry. Only at great cost could its limitation be surmounted. Suddenly Crosley offered the radio world a cone speaker at $17.50. Instantly the demand exceeded the supply. Promptly loud speaker sales were gauged by the leadership of the Musicone.

Today that position is still maintained. The cause is plain. Mechanical refinement and improvements of the Musicone since its inception have been constant and considerable.

Price of the Musicone has shown a steady downward trend from $17.50 in 1925 down to $9.75 at the present time.

Only a national acceptance could make this possible and only a remarkable value could create such a national acceptance.

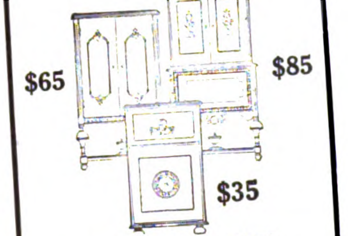
Today the Musicone is a perfect reproducer thru—

1. A new metallurgical discovery giving many times the vibrating capacity of the actuating unit as formerly.
2. Bakelite coil cores impervious to moisture.
3. Secretly coated wire that does not permit deterioration in damp climates.

Crosley owners find a perfect affinity between the Bandbox and the Musicone aside from their physical appearance.

The Musicone is sold in two sizes:

The Ultra Musicone (12-inch) . .	$ 9.75
The super Musicone, as illustrated (16-inch)	$12.75



APPROVED CONSOLES

"I want the public to have as great a value in consoles this year as I have given them in the Bandbox" said Powel Crosley, Jr.

Prominent furniture manufacturers thru their long experience promised beautiful cabinets at moderate prices. Designs submitted were admired. praised, tested, approved! The Musicones were built in. Crosley dealers now sell them. Purchasers may know they are best suited for Crosley radio by looking for the "approved label" in each one. Crosley dealers get these cabinets only from The H. T. Roberts Co., located at 1340 S. Michigan Ave., Chicago, Sales representative for The Showers Brothers Co., Bloomington, Ind., and The Wolf Manufacturing Industries, Kokomo, Ind.

Write Dept. 16 for descriptive literature

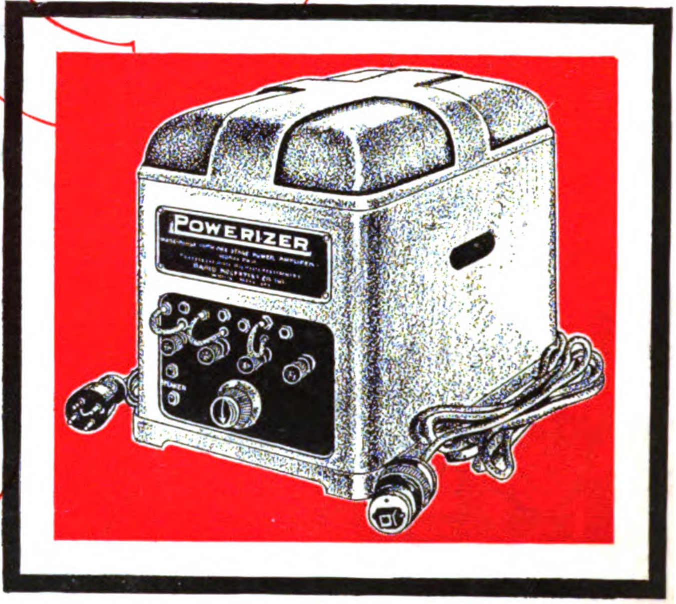
CROSLEY RADIO

THE CROSLEY RADIO CORP.
Powel Crosley, Jr., Pres.
Cincinnati, Ohio

Crosley is licensed only for Radio Amateur, Experimental and Broadcast Reception.

Montana, Wyoming, Colorado, New Mexico and West prices slightly higher.

POWERIZER



Model for Atwater Kent and other standard sets, $60
Radiola "20" model............................$59

makes your set an A. C. Electric

with the newest A. C. Radiotrons which require no batteries!

Run your Radio from your light socket—Eliminate "A" batteries trickle charge units, "B" batteries, "C" batteries and convertors ...With Powerizer you use the newest A. C. Radiotrons in any set

Cymbals crash...the great bass booms...the baritone sax sighs and moans...dance music with jungle deep intonations...music such as you've never heard from your radio before...With the Powerizer, all those elusive low notes are captured—and reproduced with a rich mellowness.

Equip your set with a Powerizer and the finest tone quality in Radio is yours—for there is installed in your set the same system of A. C. Radiotron electrification that is used in the finest $500 and $800 A. C. Receivers.

The Rolls-Royce of tone tubes is used—the UX-210 ...The Powerizer comes equipped with harness and adaptors—NO REWIRING IS REQUIRED—write for details how to make your set a 1928 A. C. Electric Receiver.

RADIO RECEPTOR CO., INC.
106 Seventh Avenue, New York

LICENSED BY RADIO CORPORATION OF AMERICA *and Associated Companies*

UNIVERSITY OF MICHIGAN
3 9015 08005 3252

BOUND
APR 18 1928
UNIV. OF MICH.
LIBRARY